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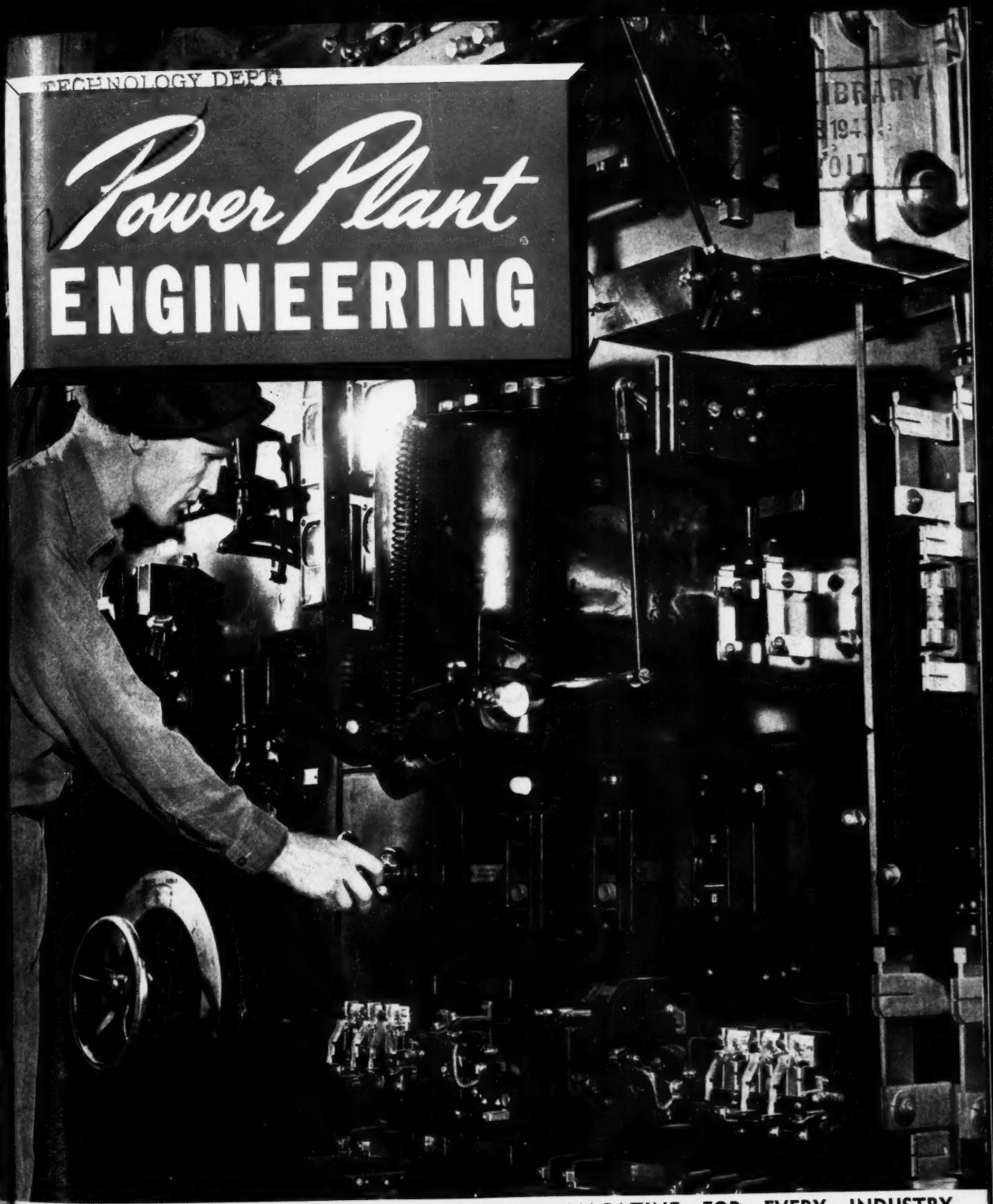
Power Plant ENGINEERING



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JULY • 1945

Features

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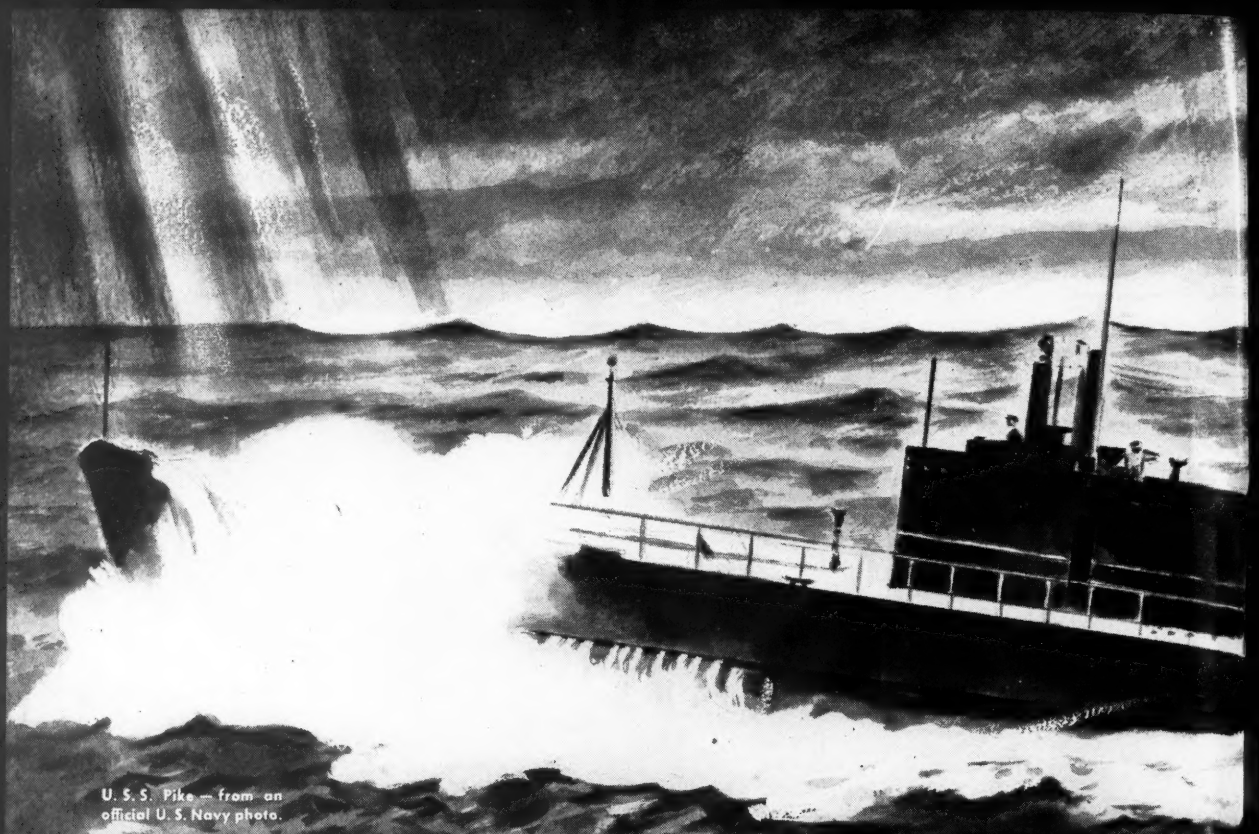

U. S. S. Pike — from an official U. S. Navy photo.

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The U. S. submarines listed have achieved distinction either through the bestowal of the Presidential Unit Citation, or the awarding of individual honors to their personnel while engaged in operations against the enemy.

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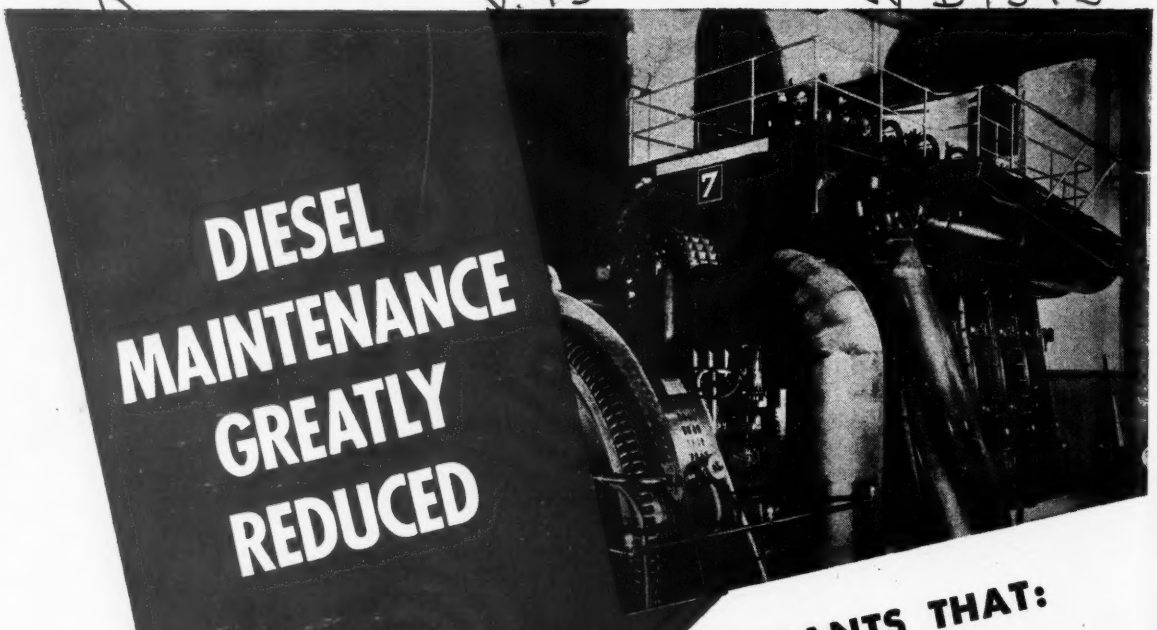
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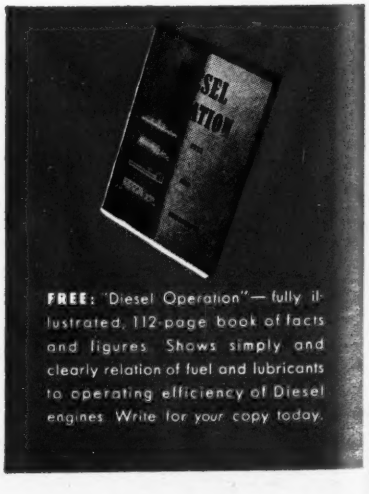

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Published Monthly by
TECHNICAL PUBLISHING CO.
53 W. JACKSON BLVD.
CHICAGO 4, ILL.

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NEW YORK: John A. Kershaw
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Subscription Information—The monthly issues are sent prepaid by second class mail. Prices: United States and possessions one year $2.00 and two years $3.00. Canada one year $3.00 and two years $5.00. Other countries one year $4.00 and two years $7.00. Address correspondence about subscriptions to Circulation Manager, POWER PLANT ENGINEERING, 53 West Jackson Blvd., Chicago 4, Illinois. Changes of address should give both old and new address and reach us by 20th of month to be effective with following month's issue. The Annual Index is furnished as a part of the December issue.

Power Plant ENGINEERING

July 1945

VOLUME 49—NUMBER 7

Cover: Mechanic setting power factor at 100 per cent from panel that controls one of the world's quietest synchronous motors. It is the largest known synchronous motor powered from a city network. It drives the compressor for the air conditioning system at the International Building at Rockefeller Center, New York.

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Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

Copyright, 1945, by Technical Publishing Company.

Published monthly by the Technical Publishing Co., at 53 West Jackson Blvd., Chicago 4, Ill., U. S. A., Subscription price, $2.00 a year. Entered as second class matter September 8, 1932, at the Post Office, Chicago, Ill., under act of March 3, 1879. Vol. XLIX, No. 7.

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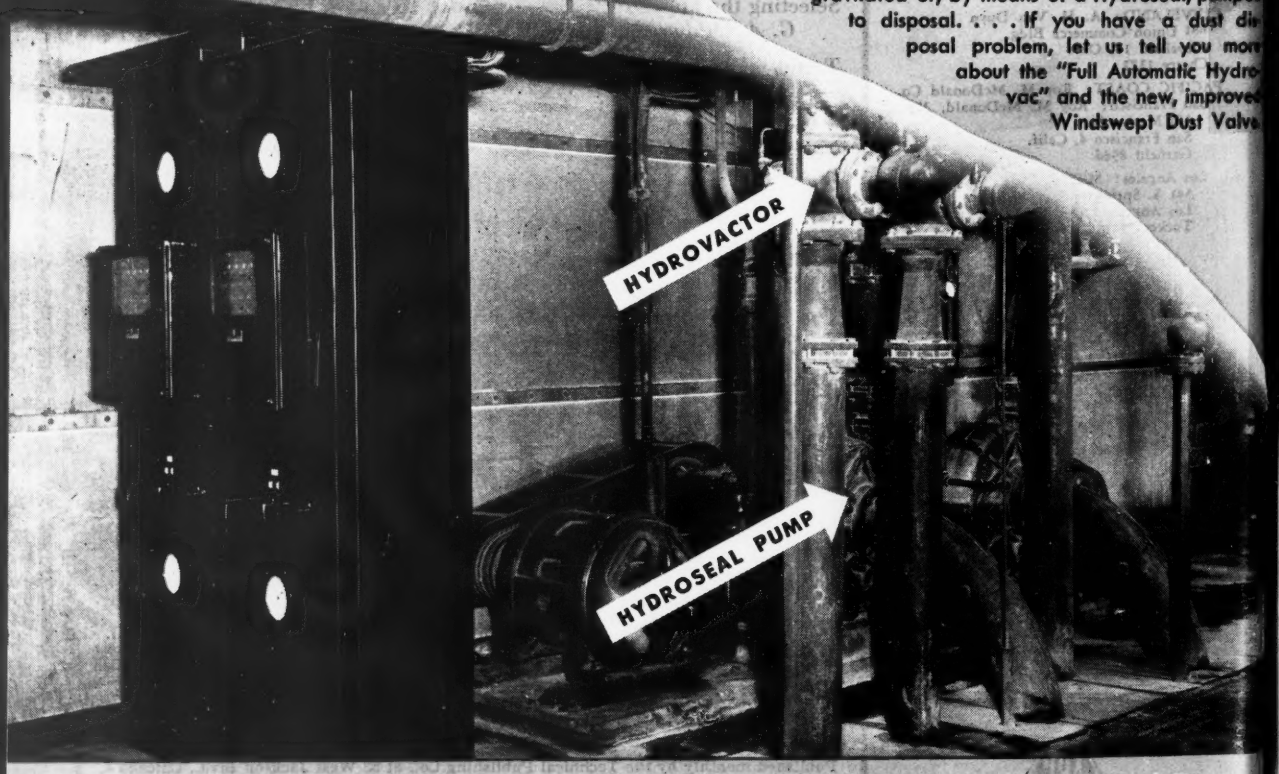

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Front Lines

IN THESE DAYS a man with a record of 68 years of continuous service for the same employer is certainly news. The AP evidently thought so when it recently reported how Harry Clough, engineer at the Venetian Blind Co. at Burlington, Vt., has outlived three boilers and two engines and still is going strong at 83. He went to work for the Crane Lumber Co. as a youth and later changed to the blind company, which is also owned by the lumber company.

IF YOU EVER WANT to hear your own heart beat, you can do it in the completely soundproof room located in the middle of the United States Navy Yard at Brooklyn, N. Y., it is claimed. This room, 18 ft by 30 ft, weighing 8 tons, is suspended on 14 columns of rubber each 16-in. high. It is used by Navy engineers for testing sensitive radio and electronic equipment used on American naval vessels. These engineers maintain that there is probably not a quieter place in all the word. The room is lined with deep layers of spun glass and other acoustical material which absorb sound, the walls are non-parallel and the soundproof room is built inside another chamber with brick walls 12-in. thick and a 6-in. concrete floor.

JOHN I. YELLOTT, formerly director of the Institute of Gas Technology at Chicago, and before that, director of the Department of Mechanical Engineering at Illinois Institute of Technology, has been appointed director of research of the BCR Locomotive Development Committee. (See Front Lines, May, page 8, column 1, paragraph 1.) Mr. Yellott assumed his new duties on May 1 with headquarters in the O'Sullivan Building, Baltimore 2, Md.

REPORTS have been reaching us from time to time of the serious problems caused by the almost incredible growth of fungi of all kinds on military equipment used in the tropics, particularly radio equipment. These fungus growths not only impair the functioning of the apparatus but also menace human health. To detect the fungi in all sorts of equipment, "black light," produced by the Inspectolite lamp, has proved extremely useful. This black light makes location of the fungus quick, simple and positive when it cannot be detected by the human eye, by causing the organism to fluoresce and glow brightly when exposed to the filtered ultraviolet rays.

"OIL IS WHERE YOU FIND IT" has for years been one of the oil man's favorite clichés. Where and how you find it are discussed in considerable detail in an article in the May, 1945, issue of On Tour. One method is geological, involving the study of the earth's crust. Another method is geophysical, employing the gravity meter and the reflection seismograph.

WHEN WE in America get to feeling "too big for our britches" as some of our Yankee forebears used to put it, somebody will probably remind us, as does Alfred B. Garrett of The Ohio State University, that it is conservatively estimated that more than one-half of the resources that the North American continent originally possessed have disappeared within the last 250 years. Between 1900 and 1925 we used up more of the world's resources of various metals and mineral fuels than had been used by man throughout his entire history prior to 1900. If we make our comparisons, as the engineer does, by relating them to an ideal theoretical performance for certain conditions, we will note that, with all our boasted technological powers, only about 5 per cent of the power in gasoline actually gets to the rear wheels of an automobile to move the car. That the very best condensing steam power plants we can build today have a maximum efficiency of between 30 and 34 per cent and there are only 3 or 4 of these. A great many others have an efficiency of not over 25 per cent and the average for the country is very much lower than that. Thousands of tons of irreplaceable iron and steel are lost each year through corrosion and other thousands of tons of many metals, also irreplaceable, are sent to the bottom of the ocean during a war. The maximum estimate of our petroleum reserves at present is about 20 years supply. After this war we had better do a little hard thinking about conserving our resources and increasing our efficiency.

"THERE IS GRAVE DANGER that some colleges and the public generally may believe that an accelerated college program is superior to the pre-war college schedule. Experience with those graduates employed in the past two years leads us to believe that the engineering graduate of an accelerated program is limited, compared with his pre-war predecessor, in his ability to analyze engineering problems from fundamentals"—Boring, Stevenson and McEachron, Jr. of GE Co. in A Reply from Industry to the Colleges, Journal of Engineering Education, April, 1945.

QUARTERLY SUMMARY OF MATERIALS CONSUMPTION for New Construction in the United States, recently issued by the Bureau of the Census, Department of Commerce, Washington, D. C., introduces a new series in the Facts for Industry group, released jointly with the WPB. Quantities of materials required for construction activity, both public and private, are broken down in four main categories: 1, Military Construction; 2. Plant Expansion; 3. Housing; and 4. All other Non-Military Construction. The effects of anticipated cancellation of conservation and limitation orders and the use of substitute materials have been taken into consideration.

ARE YOU DREAMING about the transmission of power by radio? If so, Russia may have the answer. The official Soviet News Agency reports that for one year a vehicle has carried a one ton load in a Moscow factory, the power being supplied by high frequency current picked up from wires laid underground. —Ohmite News.

CONCLUSION-DRAWERS — Do your stuff! Solar disturbances and prices seem far apart, but in Mainsprings of Civilization (John Wiley & Sons), Ellsworth Huntington of Yale University has shown that variations in the solar constant and in prices on the stock market may be closely connected by way of a cycle of 41 months in atmospheric electricity. In Fig. 1, the solid line shows the Dow-Jones averages of stock prices after secular trends and longer cycles such as nine years have been eliminated. The dotted line shows a rigid cycle of 41 months. Although great events such as the first World War and the financial crash in 1929 introduce irregularities, the maxima and minima of stock prices keep coming back into agreement with those of the rigid cycle. The lower curve in Fig. 2 shows the variability of atmospheric electricity from hour to hour, together with the same rigid cycle as in Fig. 1. The dots at the top indicate the dates of maxima in the curve of stock prices. Except in 1919 when World War I had disrupted matters, these maxima occur systematically at an interval of from three to twelve months after the maxima of electrical variability. Hence we might be led to the hypothesis that when atmospheric electricity varies greatly, man's nervous system is stimulated and a feeling of optimism and courage is aroused. This concept naturally leads to inquiry as to the cause of variations in atmospheric electricity. Terrestrial causes doubtless play a part, but studies of auroras, radio, and magnetism make it clear that most of the earth's electro-magnetic variations arise from similar variations in the sun. This conclusion is substantiated when we examine the solar constant (upper curve of Fig. 2). Thus far this whole matter is avowedly in the stage of an hypothesis. Nevertheless, the hypothesis seems to fit a great number of facts which were previously inexplicable. A more complete discussion of it is given in the November, 1944, issue of The Frontier of Armour Research Foundation and in Mr. Huntington's book.

A TESTING GAGE no longer than a paper clip, developed by Baldwin and known as the SR-4 Strain Gage, has proved extremely valuable in production of military equipment. Mounted on the barrel of a gun, for example, it measures the amount of strain that occurs during the firing of the piece.

EXTENSION of the standardization activities of the ASTM to the preparation of standard tests and specifications for ultimate consumer goods has recently been announced by the Society. Ultimate consumer goods are defined as "materials or products which in the 'as is' condition are intended for sale to an individual purchaser for his personal property or use, and not for fabrication for resale." It is intended that the standardization work on such goods shall be based upon sound engineering principles and practices and that it shall deal only with such goods as permit definitions, test data and test limitations that can be measured by engineering methods.

INCLUDED in the power plant systems of the food processing industry are 875,000 electric motors, 14 per cent of those used in all industry. The industry consumes 5½ billion kilowatt hours every year —enough electrical energy to supply the state of Maine for more than four years.

MODULAR PLANNING of new building construction might possibly develop into a major factor in lowering the cost of construction and improving the quality of structures after the war. The Bureau of Standards has been participating actively for some time on a project for coordinating dimensions of building materials and equipment and for correlating building plans and details with such dimensions. The project is sponsored jointly by the American Institute of Architects and the Producers' Council, Inc., and carried on under the procedure of the American Standards Association. Modular planning is based on a 4-in. unit or "module" that serves as the spacing for a uniform three-dimensional grid to which the building layout and details are referenced.

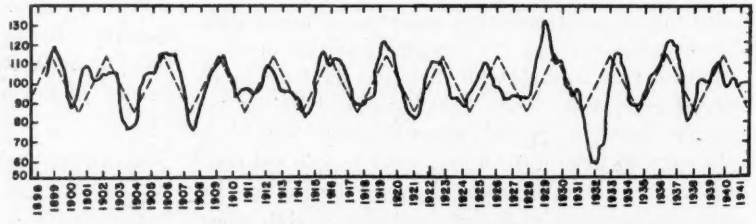


Fig. 1. Comparison of Dow-Jones average of stock prices (solid line), after secular trends and longer cycles have been eliminated, with a rigid cycle of 41 months (dotted line)

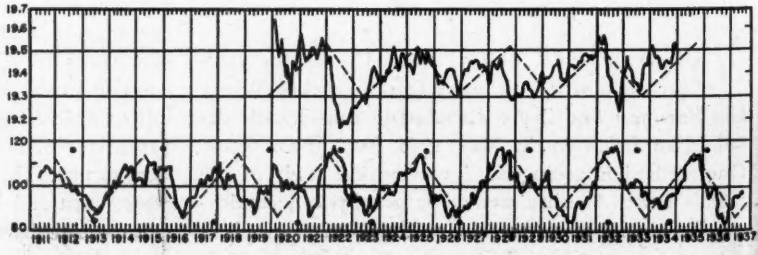
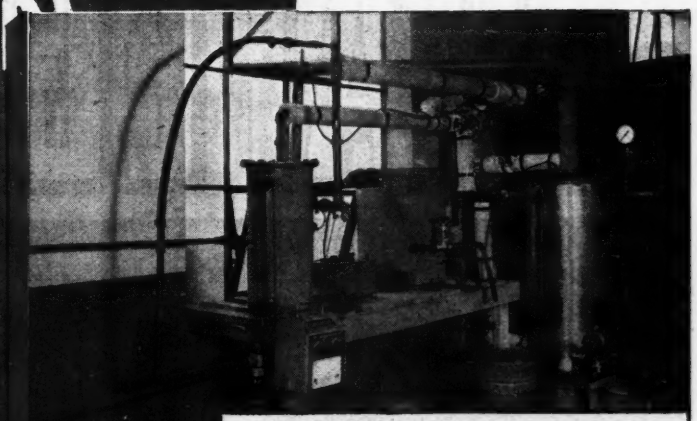
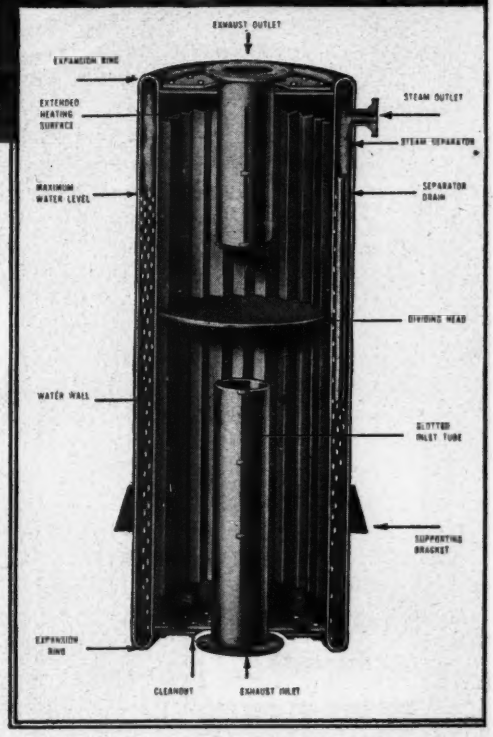


Fig. 2. Lower (solid line) curve shows variability of atmospheric electricity, compared with rigid 41-month cycle (dotted line). Dots at top indicate date of maxima in stock price curve. Upper curve is the solar constant

PUT EXHAUST HEAT TO WORK

WITH MAXIM HEAT RECOVERY SILENCERS





The illustration above shows a test hook-up for Heat Recovery Silencer research in the Maxim Research Department. Here again, as in Maxim Silencers, the basis for superior performance is constant and painstaking research which results in proper basic design and a never ending search for improvement.

Maxim Heat Recovery Silencers provide effective silencing of exhaust noise, 100% spark arresting (where this is desired) and the recovery of waste exhaust heat to produce steam or hot water for heating or processing operations.

These Heat Recovery Silencers are available with automatic controls which control steaming rate by varying water level in the water wall of the Silencer. They may be run wet or dry. Highly efficient heat transfer is assured by the Maxim extended heating surface feature.

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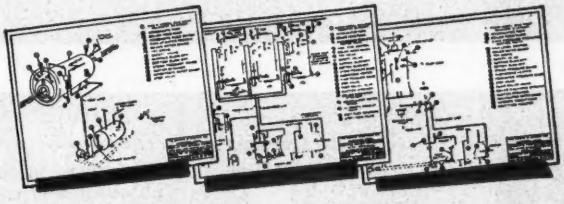
For silencing without the heat recovery feature, Maxim makes silencers for internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge, high velocity steam, air or gas discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.



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Typical Heat Recovery Silencer hook-ups are available with a detailed discussion of each. We will be glad to send them to you. Just ask for Dwgs. B-298, B-301, B-302 and B-303.

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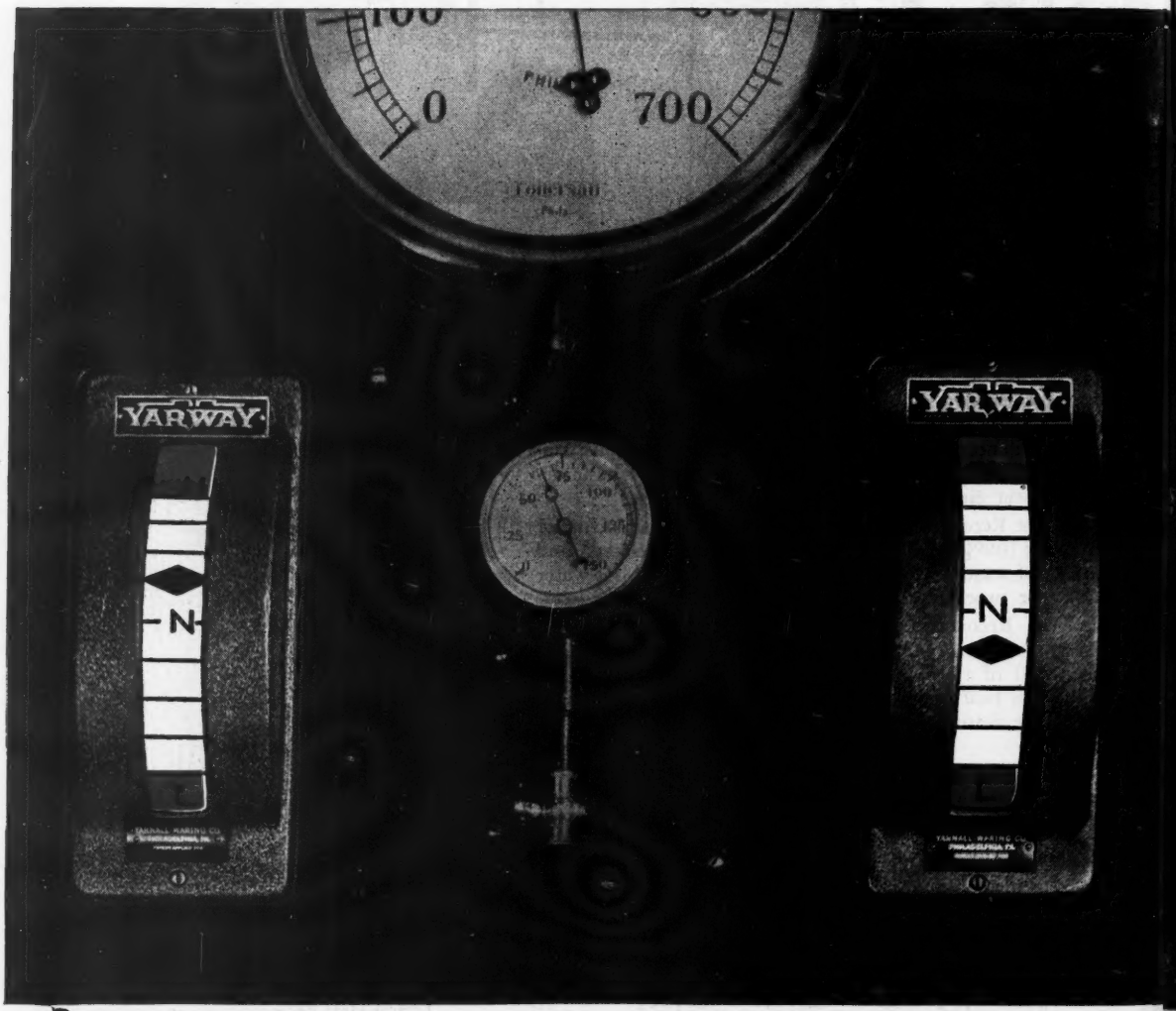
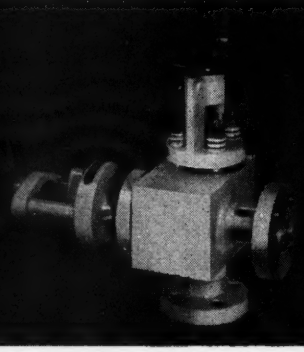


YARWAY SEATLESS TANDEM BLOW-OFF VALVES— standard in over 12,000 plants—for pressures to 600 psi. Famous balanced sliding plunger design with non-clogging, straight-through flow. No seats to score, wear and leak. Described in Catalog B-432.



YARWAY UNIT TANDEM BLOW-OFF VALVES, built for pressures up to 2500 psi. Combining a Hard-Seat blowing valve next to boiler and a Seatless sealing valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing or for draining and sealing—in a compact, rugged unit. Ask for Catalog B-432.

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Maximum protection of steam generating units is possible only with the most dependable auxiliaries. For nearly 40 years Yarway has specialized in designing, developing and manufacturing boiler auxiliaries of outstanding merit. Yarway Blow-Off Valves, Water Columns and Gages and Liquid Level Indicators are today regarded as standards by the industry.

Take, for example, the Yarway Remote Liquid Level Indicator shown at left. Introduced publicly only one year ago, this unique instrument met with wide acceptance and approval. Already well over 2000 have been bought for indication of boiler water level, feed heater water level, and superheater pressure differential.

The Remote Liquid Level Indicator answers a long-standing need for a positive, foolproof method of boiler water level indication at eye-level, on the instrument panel or any other convenient location. It is always accurate because it's operated by the boiler water itself—by the pressure difference between a constant head of water and the varying head in the boiler. The indicating mechanism is never under pressure. Its action is instantaneous, frictionless. *There are no stuffing boxes.* Mechanism is perfectly balanced on jewelled bearings outside of the pressure chamber.

It is easily installed on new or existing equipment. See diagram at right above. Suitable for all pressures up to 1500 psi. Catalog WG-1820.

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YARWAY REMOTE LIQUID LEVEL INDICATOR

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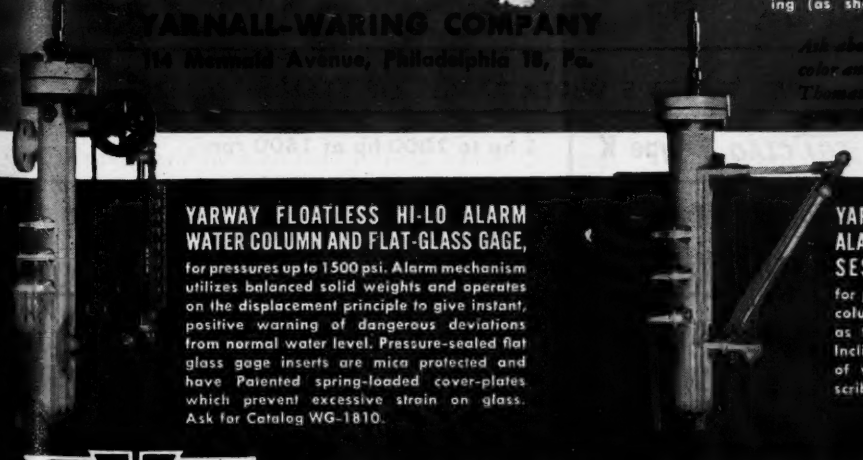

YARWAY FLOATLESS HI-LO ALARM WATER COLUMN AND FLAT-GLASS GAGE, for pressures up to 1500 psi. Alarm mechanism utilizes balanced solid weights and operates on the displacement principle to give instant, positive warning of dangerous deviations from normal water level. Pressure-sealed flat glass gage inserts are mica protected and have Patented spring-loaded cover-plates which prevent excessive strain on glass. Ask for Catalog WG-1810.

YARWAY FLOATLESS HI-LO ALARM WATER COLUMN WITH SESURE INCLINED GAGE, for pressures up to 400 psi. Water column operates on same principle as that described at left. Sesure Inclined Gage gives easier reading of water level from below. Described in Catalog WG-1810.

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now your Big drives

NEW 2000-hp INDUCTION MOTOR LARGEST MEMBER OF TRI-CLAD FAMILY

Dwarfing the original Tri-Clad motor (resting on the conduit box) in size, this new 2000-hp "big brother" embodies all the same protective construction features.

It operates at 1800 rpm, on 2300 volts, 60 cycles. This new 3-phase motor is in the 6360-frame series, which is five steps larger than the largest standard industry frame size (namely 505).

* THE EXTRA TRI/CLAD

REG. U.S. PAT. OFF.

Special motors can be custom built in Tri-Clad design for *your* problem

Your exceptional drive requirements may call for an induction motor specially designed to the job. Whatever its rating, it can generally be built with many of the Tri-Clad motor's strong points, such as enclosed upper portion, smooth cast-iron end shields, windings of Formex wire, and double-end ventilation.

General Electric's special motor engineering has produced the world's fastest motor, the world's strongest motor, and many other tradition-breaking designs. We'll welcome your unusual problems.

HERE'S TODAY'S WIDER RANGE OF STANDARD SIZES	
TRI/CLAD **Type K**	**1 hp to 2000 hp at 1800 rpm**
TRI/CLAD **Type KG** (High starting torque, low starting current)	**5 hp to 200 hp at 1800 rpm**
TRI/CLAD **Type KR** (High starting torque, high slip)	**Available to 100 hp in speeds required for high-slip flywheel drive (punch press, etc.)**

TRI/CLAD MOTORS

Buy all the BONDS you can—*and keep all you buy*

can have it, too*

PROTECTION OF CONSTRUCTION

G-E STANDARD Tri-Clad Induction Motors Now Available to 2000 hp

For that important *big* drive (up to 2000 hp, 1800 rpm) you can now get a G-E standard Tri-Clad induction motor. All the protective features that have proved so valuable to service continuity and long life in the more widely used sizes are included:

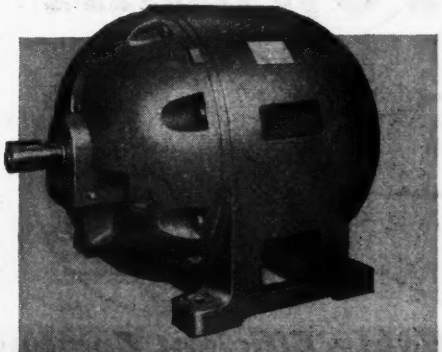
EXTRA PROTECTION FROM PHYSICAL DAMAGE—Cast-iron construction with upper portion completely enclosed to keep out falling objects, dripping liquids. Streamline, cast-iron end shields. Corrosion-resisting finish.

EXTRA PROTECTION FROM ELECTRICAL BREAKDOWN—Windings of Formex* wire are solidly bonded with synthetic resins strongly resistant to heat, oil, and moisture. Formex wire insulation stands up strongly under abrasion or "heat-shock."

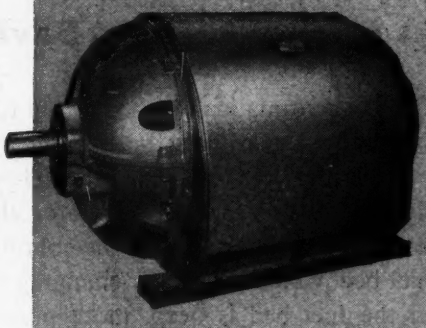
EXTRA PROTECTION FROM OPERATING WEAR AND TEAR—Available with either sleeve or ball bearings—in dust-tight housings. Sleeve-bearing design is a further refinement of well-proved Tri-Clad motor bearing proportions, efficiently lubricated, with "air seal" to insure oil tightness of the housing.

The Tri-Clad, in its wide range of types and sizes, is G.E.'s most widely used (integral-hp) motor. Chances are that there's a Tri-Clad to meet your requirements "on the nose." For information on General Electric's complete line of Tri-Clad motors, ask for GEA-3580. *General Electric Company, Schenectady 5, N. Y.*

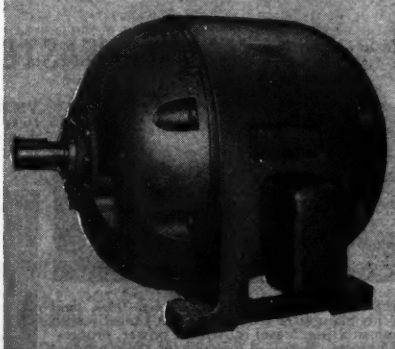
*Trade-mark reg. U.S. Pat. Off.



Typical large-size sleeve-bearing Tri-Clad polyphase motor, now standard up to 2000 horsepower.



Modified cast-iron frame construction used for certain large sizes of the extended Tri-Clad motor line.



Separable housing construction used for large-size ball- or roller-bearing Tri-Clad motors. Roller bearings are standard at coupling end.

GENERAL ELECTRIC

IRON FIREMAN POWERAM STOKERS

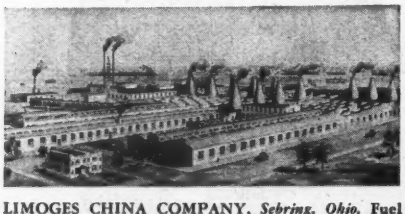
-Better Firing with Less Fuel and Manpower

Highly Efficient Combustion under Automatic Control results in Fuel & Labor Savings

COAL is automatically fed into the furnace in the exact amount needed, no matter how much the load may change. However, supplying the right volume of air for efficient combustion is complicated by the condition of the fuel bed, which is an ever changing factor. When the fuel bed is deep, more pressure is required to force the proper amount of air through the fire. With a shallow fuel bed less air pressure is needed. The Iron Fireman Volumeter, one of many features reflecting Iron Fireman's advanced engineering, performs this sensitive and continuous regulation of the air supply. It is instantly responsive to the condition of the fuel bed and meters the air accordingly.

Efficient combustion, which cuts fuel tonnage, is only one source of Iron Fireman economy. Further savings result from the use of a lower priced coal than could be successfully used in hand-firing. Iron Fireman saves manpower, too. All models are under full automatic control and require little attention. Coal-Flow models feed directly from the main coal bunker to the boiler.

CAN YOU AFFORD TO WASTE WHAT IRON FIREMAN USERS ARE SAVING?

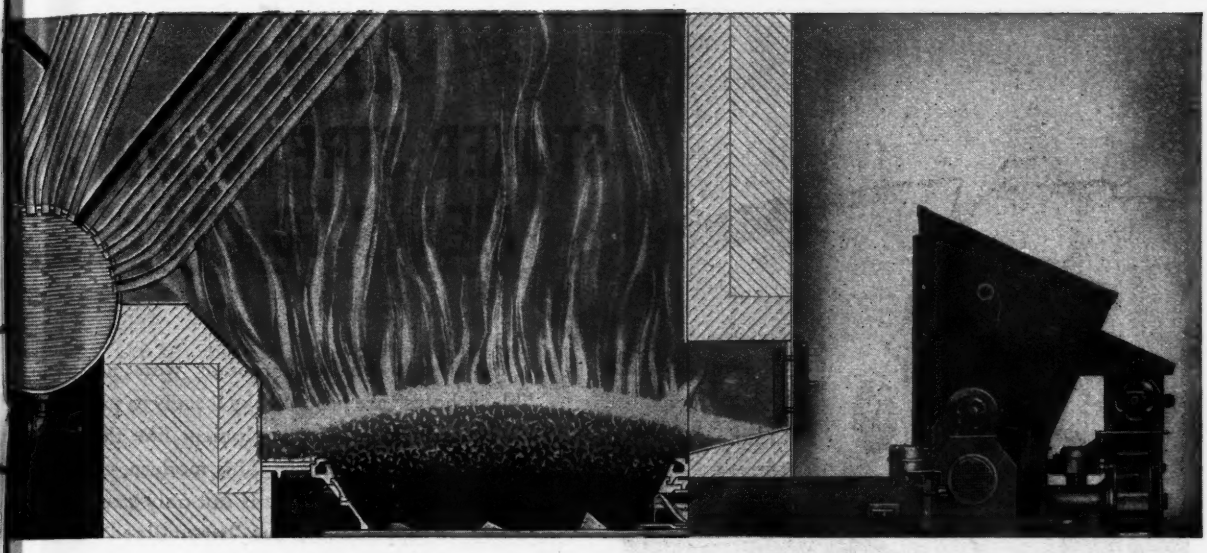


LIMOGES CHINA COMPANY, *Sebring, Ohio.* Fuel costs in this plant were reduced $2,448 annually with Iron Fireman firing. Steam is used for power, processing and heating. Increased demand for their product resulted in installation of a second Iron Fireman stoker.

VICK CHEMICAL COMPANY, *Philadelphia, Pa.* In addition to meeting rapidly changing steam requirements, Iron Fireman stokers have cut fuel costs drastically over former method of firing, thus reducing coal tonnage.

NATIONAL TRANSIT CO., *Bear Creek Pumping Station, Parker's Landing, Pa.* Nine Iron Fireman Poweram stokers maintain steady steam pressure, under heavy load conditions, 24 hours a day, 7 days a week.

IRON FIREMAN

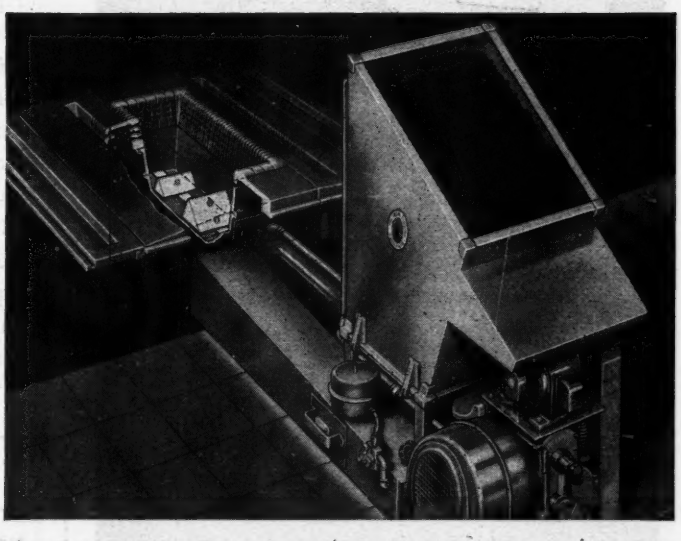


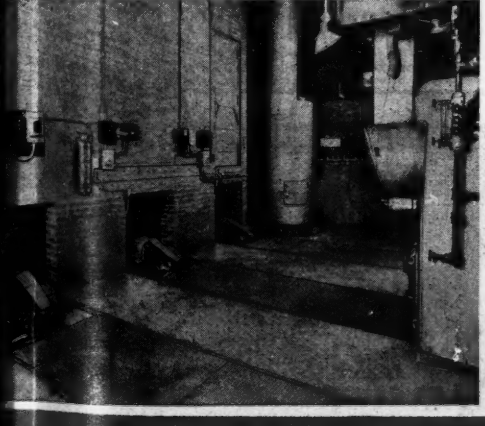
THE IRON FIREMAN POWERAM

A Heavy Duty Stoker for Boilers up to 500 h.p.

The sectional view of the Iron Fireman Poweram, above, explains the merits of the Iron Fireman underfeed fire, in which new fuel is introduced below the fire bed. As the coal rises in the retort and its temperature gradually reaches the combustion point, the more volatile elements are distilled off. They do not escape unburned, for they must pass through the fuel bed. No wasteful, smoky fire.

Coal is conveyed from the hopper or bunker by a worm conveyor, which does not compress the coal, but delivers it to the retort in a loose and aerated condition. Reciprocating pusher blocks in the base of the retort distribute the coal without packing. This combination of worm conveying and ram distribution is an exclusive Poweram feature.





Above: Hopper model Iron Fireman Poweram Stoker. Precision manufacture, sound engineering and ample reserves of strength result in extremely low maintenance costs. *Left:* Multiple boilers served by heavy duty Iron Fireman Coal-Flow Stokers. In this installation the conveyor worms are housed under the floor plates.

THERE IS AN IRON FIREMAN FOR EVERY FIRING NEED. Iron Fireman stokers are available in many sizes and models to meet the most varied commercial and industrial requirements. Iron Fireman engineering assures you the correct stoker for your plant, taking into account fuel, load and operating conditions.

YOU CAN HAVE A FREE ENGINEERING SURVEY OF YOUR BOILER ROOM. A free engineering survey will give you valuable information about your own boiler plant, and recommendations for improvements where needed. Call your local Iron Fireman dealer for survey or catalog, or write to Iron Fireman Manufacturing Company, 3849 West 106th Street Cleveland 11, Ohio.

AUTOMATIC COAL STOKERS

Iron Fireman Commercial and Industrial models fire boilers up to 1000 h. p. and larger

What

STOKER STREAMLINING MEANS TO YOU

The days when boiler rooms were noisy "black holes" are past, thanks largely to progress in fuel firing equipment like the Æ Perfect Spread Stoker. This modern, completely automatic stoker is not only streamlined in appearance, but "streamlined" in principle, design and operation.

Its compact, fully-protected mechanism runs quietly and steadily, without clogging. It economically burns all kinds and grades of solid fuel, including by-products and refuse . . . with consistently thorough combustion at a low operating cost.

In plants using steam for power, heating or processing, the Æ Perfect Spread Stoker assures important yearly savings. Be sure to *get the facts* that may favorably affect your whole future operation. Write for this new Bulletin, today!

STREAMLINED—UNDER COVER—QUIET!

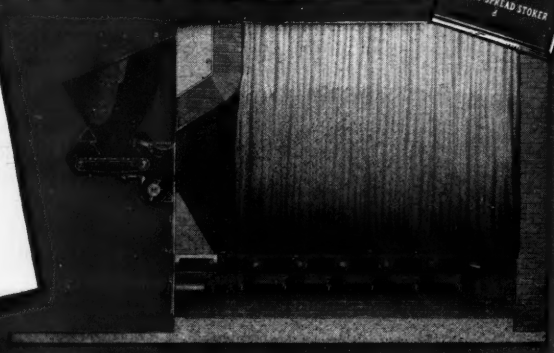
The all-enclosed, protected mechanism includes automatic, variable-speed feeder with non-clog safety feature and is accessible without tools for inspection or adjustment by merely lifting cover. Simplified construction, water cooling at vital points, and many other features add up to unusually quiet, efficient operation.

If Your Steam Requirements Call for 175 H. P. up to 200,000 lbs. per hour—

YOU NEED THIS BULLETIN

Write us. 2408 Aramingo Ave., Philadelphia 25, Pa.

Æ PERFECT SPREAD STOKER



AMERICAN ENGINEERING COMPANY

Subsidiaries: COCHRANE CORPORATION, Philadelphia, FARADAY ELECTRIC CORPORATION, Adrian, Mich.

PHILADELPHIA 25 PENNSYLVANIA

15 MINUTES

MAY ALTER YOUR POWER OUTLOOK!

The few minutes it will take you to examine the new booklet describing the Improved Æ Taylor Stoker may mean much to you and your company. In it you'll see new features that add years of progress to the design, operation and performance of this time-tested stoker.

You'll see how simplified unit construction reduces installation costs; how the unique continuous ash discharge is automatically timed; how slag formation is minimized; how "finger-tip" ash discharge becomes a reality; how precision feed and better air flow maintain uniformly thorough combustion; how fewer moving, longer wearing parts contribute to lowered steam costs.

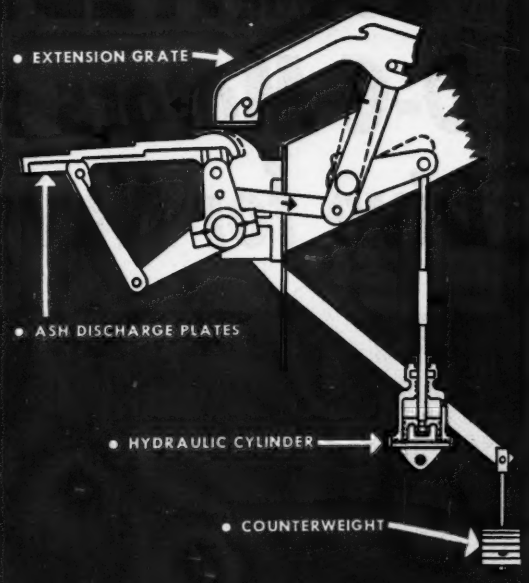
You'll see why these improvements in the Taylor Stoker logically provide even greater efficiencies and economies than previously. Before you decide on *any* equipment take time to send for and study this booklet. It will be time well spent.

IF YOUR Steam Requirements Call for 20,000 to 500,000 lbs. per hour—

YOU NEED THIS BOOKLET

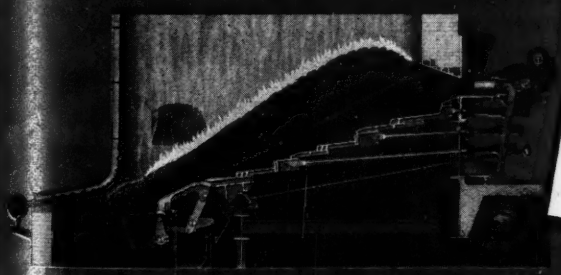
Write us. 2408 Aramingo Ave., Philadelphia 25, Pa.

ANOTHER IMPROVED FEATURE OF THE TYPE "R" TAYLOR STOKER



Hydraulically driven independent of the main stoker drive, reciprocating discharge plates provide ash movement ALL-THE-WAY TO THE END OF THE STOKER.

Rearward and slightly upward movement of overfeed section effectively moves ash onto the discharge plates. When overfeed section completes rearward travel, continuation of ash movement to point of discharge is assured by rearward travel of discharge plates.



Æ TAYLOR STOKERS

AIR-COOLED & WATER-COOLED

AMERICAN ENGINEERING COMPANY

Subsidiaries: COCHRANE CORPORATION, Philadelphia, FARADAY ELECTRIC CORPORATION, Adrian, Mich.

PHILADELPHIA 25, PENNSYLVANIA

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WANTED: D-C Motors to Dive for Navy!

BUILD SUBMERSIBLE MOTORS to run 25 feet under water — and build 'em to run that way 90 days at a stretch? That's the tough assignment Navy engineers turned over to Allis-Chalmers.

Those motors had to: 1) withstand sea pressure; 2) stay waterproof; 3) be light in weight.

No. 1 problem was... *how to build water-tight casings.* A-C engineers experimented, found the solution in fabricated steel.

Quickly, individual casing parts were built. Subsequent hydrostatic tests applied to them showed molecular arrangement and carbon content of steel to be ok. Result —only a heavy weld between fabricated parts was needed to assure water-tightness!

Now the going was easier. For adequate surface seal, field yokes of one-inch rolled steel were used. End housings were reinforced. Exposed adjustments were made leakproof. Then . . . minor changes in insulation, at other points, and the problem was solved.

* * *

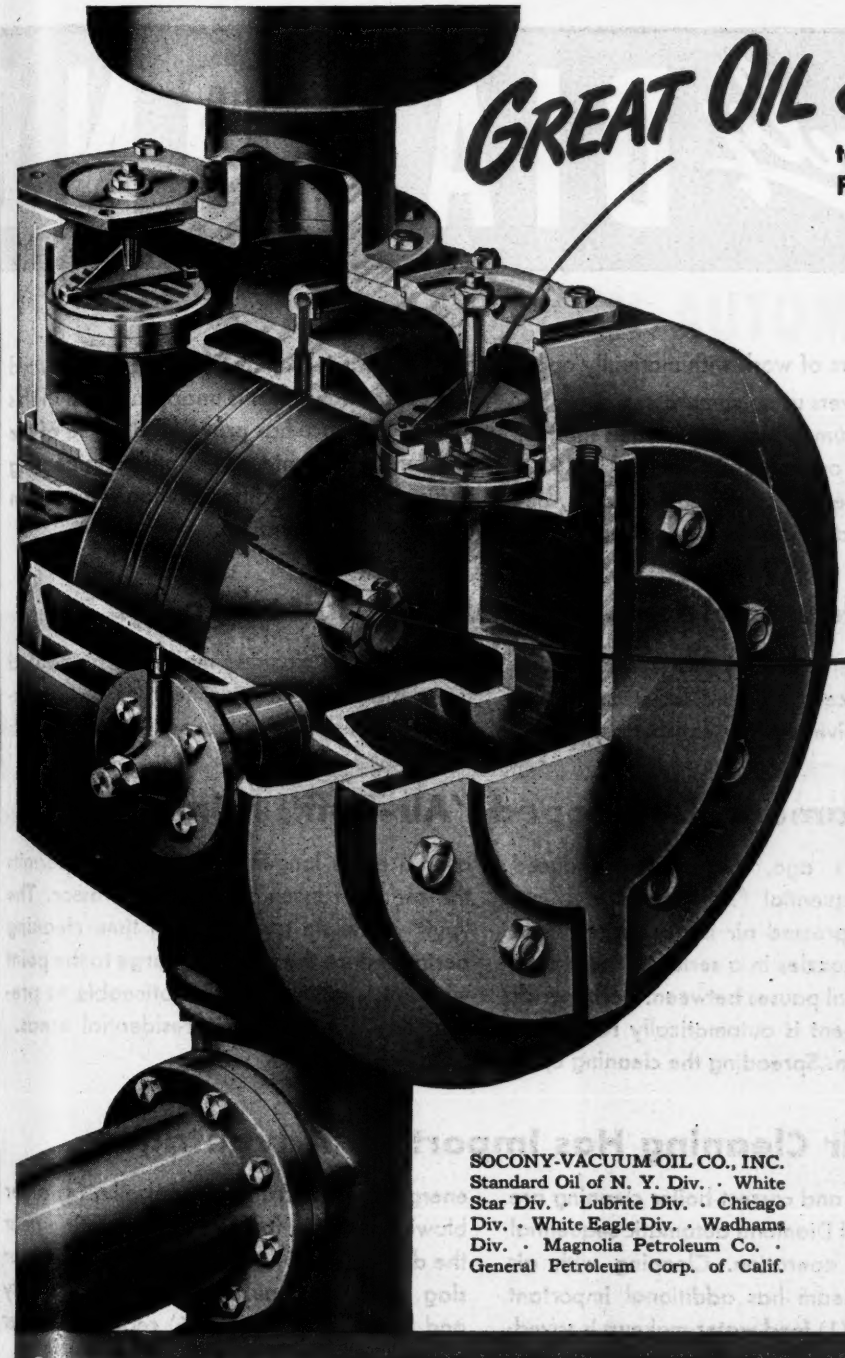
"What's all this got to do with *my* problems?" you may ask. Just this... Everytime A-C tackles the job of building special motors for extra-tough war applications, like this one, it also discovers important new ways to build better *standard* motors for you!

That's why you hear it said so often, *"You can depend on Allis-Chalmers Motors!"* ALLIS-CHALMERS, MILWAUKEE, WIS.

A 1889

You Can Depend on ALLIS-CHALMERS Motors

For Doubly-Safe Air Compressor Lubrication, You Need



GREAT OIL STABILITY

to Keep Discharge Valves Free of Dangerous Deposits

You can be sure of maximum freedom from valve-clogging deposits with Gargoyle D.T.E. Oils in your air compressor.

For these famous Socony-Vacuum oils possess high chemical stability to fight off the attacks of oxygen at hot discharge temperatures. By keeping valves clean and free, they prevent leakage, higher discharge temperatures and lower capacity.

Here, in this "hot spot," they're your assurance of greater all-around compressor efficiency.

STRONG FILMS

to Minimize Cylinder Wear

You get protection against wear as well as against deposits, when you rely on these proved oils. Their high lubricity minimizes metal-to-metal contact on rings, pistons, and cylinders *with* minimum oil feeds. This reduction in the amount of oil needed for correct lubrication, means less oil carried to the valves and the system, still another safeguard against deposits.

Why be satisfied with anything less than the best for your compressor? See your Socony-Vacuum Representative for his recommendation on the proper grade of Gargoyle D.T.E. Oil.

SOCONY-VACUUM OIL CO., INC.
Standard Oil of N. Y. Div. · White Star Div. · Lubrite Div. · Chicago Div. · White Eagle Div. · Wadhams Div. · Magnolia Petroleum Co. · General Petroleum Corp. of Calif.

SOCONY-VACUUM'S 5 Steps to Lower Production Costs:

1. Lubrication Study of Your Entire Plant
2. Lubrication Schedules and Controls
3. Lubricant Storage and Handling System
4. Skilled Engineering Counsel
5. Progress Reports of Benefits Secured

GARGOYLE Lubricants

Only DIAMOND

Following years of work with manually operated soot blowers using compressed air as the cleaning medium, Diamond installed the first automatically operated air blowers in 1932. Since that time the continuous research, development and application engineering that has been carried on by Diamond has resulted in a "know how" that is unapproached in this field. Experience has proved that some of the problems encountered — both engineering and economic—are different than when steam is the cleaning medium.

Blower Heads Particularly Suited To Air

Experience early proved that certain heads long very successfully used for steam cleaning did not give equally satisfactory results with air as the cleaning medium. This caused the design and development of heads expressly suited to air blowing.

Diamond Developed "Air-Puff" Principle

Sixteen years ago, Diamond introduced automatic sequential "Air-Puff" soot blowing. The compressed air is discharged from the element nozzles in a series of short puffs with substantial pauses between. During each puff the element is automatically rotated to a new position. Spreading the cleaning cycle over a much longer period of time permits the use of a much smaller compressor. The "puff" principle and the long time cleaning period reduce the stack discharge to the point where it is not sufficiently noticeable to prevent daylight blowing in residential areas.

Air Cleaning Has Important Advantages

Labor saving and correct boiler cleaning are common to all Diamond automatic sequential soot blower operation. Cleaning with air instead of steam has additional important advantages: (1) feed water makeup is saved; (2) no piping insulation is required; (3) more energy is saved from the coal pile; (4) dryer blowing medium for surfaces operating near the dew point; (5) more effective medium for slag removal because of its greater density and lower temperature; (6) reduced blower maintenance.

DIAMOND POWER

HAS THIS BACKGROUND OF

Experience IN AUTOMATIC SOOT BLOWING WITH Air

Power Boilers having DIAMOND Automatic Soot Blowing with AIR

*ENTRAL TATION	DATE BOILER IN SERVICE	STEAM CAPACITY OF BOILER	TYPES OF AIR BLOWING HEADS USED	METHOD OF OPERATION	METHOD OF CONTROL
A	Sept. 18, 1940	900,000 lb/hr	5	Air and Electric	Air and Electric
A	May 5, 1941	900,000 lb/hr	5	Air and Electric	Air and Electric
B	June 18, 1942	550,000 lb/hr	3	Air and Electric	Air and Electric
B	Sept. 29, 1942	900,000 lb/hr	2	Air and Electric	Air and Electric

Names and additional information furnished on request

SPECIALTY CORP. Detroit 31, Mich.

DIAMOND SPECIALTY LTD. · Windsor, Ontario

"Engineered Lubrication"...

TYCOL

GREEN CAST GREASES REDUCED APPLICATIONS BY 33⅓% AND CONSUMPTION BY 66⅔%

One well-known plant met the usual trouble of extreme pressures with the resultant excessive wear on a huge piece of equipment — changing to *Tycol Green Cast Grease* stopped this highly unsatisfactory condition immediately.

Why do Tycol Green Cast Greases stand up in the toughest lubricating jobs — where other greases quickly run out or separate into caked soap deposits? The answer is simple. Tycol Green Cast Greases are made from high quality cylinder stock and well refined neutral oil combined with a minimum of soap for a given consistency. Green Cast Grease is water repellent . . . and is engineered to "take it" under all conditions.

A Tide Water Engineer will be glad to give you full information.

DRUMS! DRUMS! DRUMS!

War needs make it extremely important that all empty drums be returned as soon as possible.

TYCOL

TYCOL INDUSTRIAL

ENGINEERED FOR EVERY

...the TYCOL way

CUTS DOWN REPAIRS...
SPEEDS UP PRODUCTION

If you want peak efficiency . . . low-cost operation — turn to Tycol "Engineered Lubrication" for all-important help in securing these results. Why? Because each Tycol lubricant is scientifically engineered to meet definite service conditions . . . to reduce wear and maintenance costs to a minimum. That's why so many successful operators have turned to Tycol for low-cost lubrication.

In developing this individualized line of lubricants, Tide Water has complete control over its own products — from oil field, through transportation, to refining. The most modern processes are used to refine selected crudes . . . to blend and compound Tycol's "specifically engineered" oils and greases.

For complete information regarding the specific oils and greases best suited to meet your requirements, call or write your nearest Tide Water Associated office. There a Tide Water engineer, thoroughly experienced in all phases of industrial lubrication, will give you the full benefit of his knowledge.

Have you received your copy of "Lubricania"?

This informative handbook, "Tide Water Associated Lubricania", gives clear, concise descriptions of the basic tests used to determine important lubrication properties — Pour Points, Viscosity, Neutralization, and many others. For your FREE copy write: Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

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TIDE WATER ASSOCIATED OIL COMPANY

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Specify Republic

A Republic combustion control system operates the three boilers in this new power plant which supplies all the steam and power for a large university. During the first year of operation this new plant provided heat for 13.(percent more building space, generated 114.3 percen more electric power but consumed 9.86 percent less fuel

REPUBLIC
INSTRUMENTS
AND CONTROLS

Combustion Control

TO INCREASE TODAY'S STEAM PRODUCTION

TO DECREASE TOMORROW'S STEAM COST

The installation of Republic automatic controls on your boiler (or boilers) will enable you to:—

SAVE FUEL by automatically maintaining highest combustion efficiency.

INCREASE STEAM OUTPUT by operating the boilers at test efficiency 24 hr. a day, 7 days a week.

CONSERVE MANPOWER by automatically performing the many routine repetitive adjustments.

REDUCE OUTAGES by maintaining uniform operating conditions and thereby prevent the chain-of-event type of trouble that frequently developes as a result of incorrect boiler operation.

An automatic combustion control system, as designed and built by Republic, will help you meet today's need for more steam and tomorrow's need for lower steam costs.

The Republic combustion control is a unified system controlling simultaneously, in measured quantities and in correct proportions, the fuel and air input to the boiler. It increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency. It not only checks operation but automatically makes necessary corrections of individual factors before faulty operation has a chance to develop.

The difference between such a control and an assembly of uncoordinated regulating devices is comparatively small in equipment but great in principle. Merely to provide automatic operation of a number of individual device is not enough.

CHECK THESE FEATURES

Built into the Republic combustion control systems are many features that enable it to fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of everyday operation.

Check the following features against your list of "musts" for a perfect combustion control system.

CENTRALIZED CONTROL: The operation and control of the boiler or boilers is centralized at the master controller.

FUEL-AIR RATIO INDICATOR: The master controller is provided with mercury manometers which indicate the measured fuel and air inputs to the boiler and the fuel-air ratio.

FUEL-AIR RATIO ADJUSTMENT: A handwheel on the front of the master control panel provides a convenient means for adjusting the fuel-air ratio.

ALL BOILER RATINGS: Maintains proper fuel-air ratio over the entire range of boiler ratings.

CONSTANT STEAM PRESSURE: Maintains the plant steam pressure within narrow limits of variation by proportioning the fuel and air inputs to the load.

LOAD DISTRIBUTION: Provides a means of distributing the load among the boilers as desired.

MANUAL CONTROL: Boiler ratings can be controlled manually by a handwheel located on the front of the panel.

Find out about Republic control systems. One of our engineers will be glad to consult with you at any time. Write us today.

Republic Flow Meters Co.

2224 Diversey Parkway • Chicago 47, Illinois

12 EASY METHODS OF IMPROVING VOLTAGE ON YOUR PLANT CIRCUITS

HOW TO CORRECT LOW VOLTAGE

Feeder Voltage Condition	Circuit Loading	Power Factor	Correct by means of	See Fig.
Low	Normal	Good	Transformer tap setting	1
			Voltage regulator	2
			Autotransformer	3
High feeder drop	Normal	Good	Voltage regulator	2
			Parallel circuit	4
			Autotransformer	3
High feeder drop	Normal	Low	Shunt capacitors	5
			Voltage regulator	2
High feeder drop	Overload	Low	Shunt capacitors	5
			Shunt capacitor and voltage regulator	6

HOW TO CORRECT HIGH VOLTAGE

Normal drop	Normal	.....	Voltage regulator	2
			Transformer tap setting	1
Normal drop	No load	.....	Voltage regulator	2
			Transformer tap setting	1
Voltage rise	"No load" (except shunt capacitors are on)	Leading at no load	Automatic switching of capacitors	7
			Voltage regulator (if no penalty clause for leading power factor)	6

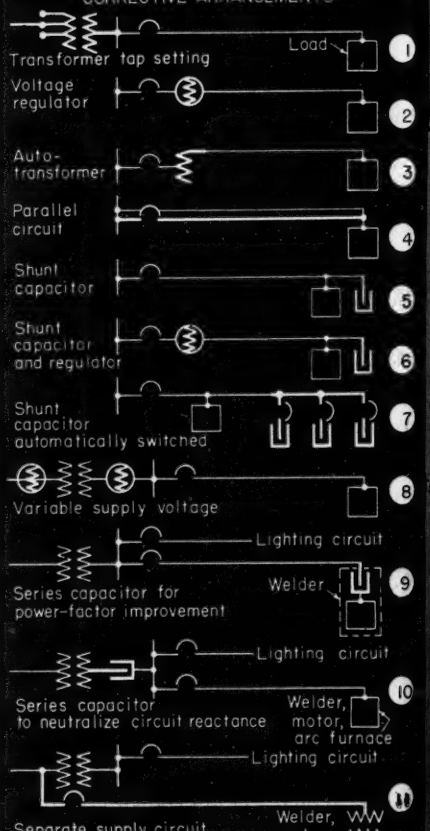
HOW TO CORRECT VARIABLE SUPPLY VOLTAGE

(Use voltage regulator or stabilizer) 8

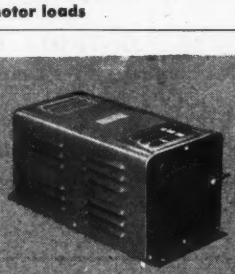
HOW TO CORRECT LIGHTING FLICKER

Load Causing Flicker	Correct by means of	See Fig.
Resistance welders, spot or seam	Series capacitor with welder to reduce demand by power-factor correction	9
	Series capacitor in line to neutralize system reactance	10
	Separate welder supply circuit	11
	M-g set for lighting circuit	12
Flash and resistance welders	Separate welder supply circuit	11
	M-g set for lighting circuit	12
Motor loads, such as: sawmills, rubber mills, grinders	Series capacitor in line to neutralize system reactance	10
	Separate motor supply circuit	11
	M-g set for lighting circuit	12
Arc furnaces	Same as for motor loads	

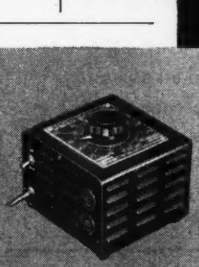
SCHEMATIC DIAGRAMS OF CORRECTIVE ARRANGEMENTS



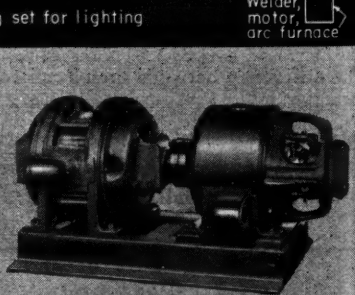
THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB BETTER



Voltage stabilizers—Automatically provide a constant 115-volt supply to a given load on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes. Ask for Leaflet GEA-3634.

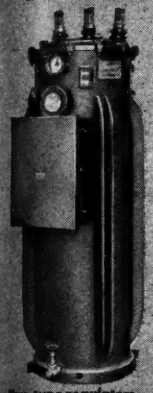


Variable-voltage autotransformer—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factory and laboratory. Described in Leaflet GEA-3635.



Motor-generator sets—Change a-c to d-c. Provide an inexpensive way to supply your lighting circuits independent of your power circuits to avoid lighting flicker. See diagrams 11 and 12. Described in Leaflet GEA-1945 (synchronous type); Leaflet GEA-394 (induction type).

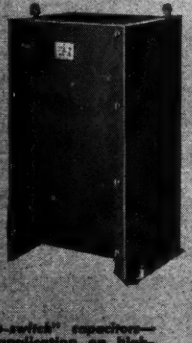
FOR SUCH CIRCUITS WE RECOMMEND THESE AIDS TO BETTER VOLTAGE



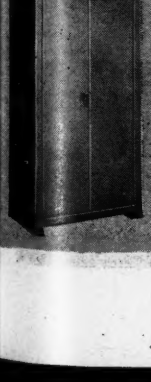
Pyranol or oil-filled regulators—Ideal for regulating variable line voltage (see diagram 8), or voltage on plant feeders. Provide 10% regulation raise and lower; automatic operation; 12 to 120 kva, 2400 to 6900 volts. Described in Leaflets GEA-3443 (Pyranol), GEA-2018 (oil, 24 kva and smaller), GEA-2985 (oil, 34.5 kva and larger).

Dry-type regulators—Automatic types Provide 10% regulation raise and lower on circuits such as diagram 2. Remote-motor or hand operated: for laboratory or testing (100% raise and lower). Ratings up to 12 kva, 600 volts. Described in Leaflet GEA-3037.

Dry-type transformers and autotransformers—For insulating lighting circuits, reducing light flicker, boosting or stepping down voltage, and phase changing. See diagram 3. Ratings up to 100 kva, 600 volts. Ask for Leaflet GEA-897.



Pyranol capacitors (series or shunt type)—For reducing kva demand, improving power factor, increasing circuit loadability on such circuits as shown in diagrams 5, 6, 9, 10. Described in Leaflet GEA-2742 for circuits 575 volts and below; Leaflet GEA-2860 for circuits 2400 to 13,800 volts.



"Auto-switch" capacitors—For application on high-voltage side of step-down transformers. Units are automatically connected or disconnected with rise or fall of voltage or current. Ideal for improving power factor at heavy load without causing overvoltage at light loads, thus reducing burnouts and replacement of lamps, coils, etc. Detailed information on request.

They will help you gain some or all of these benefits

- Improved lighting (higher levels and the reduction or elimination of flicker); better starting of fluorescent lighting; longer lamp life
- Increased motor efficiency; greater starting and running torque and speed; the reduction of motor heating and, hence, maintenance and machine outages
- Reduced breakage and spoilage in textile and other mills where motor speeds must be constant
- Better performance and greater reliability of electric equipment; the elimination of sluggish operation of potential or control devices
- Greater production from electric furnaces, infra-red heaters, drying lamps, and a wide variety of other electric equipment
- Quality control and greater uniformity, fewer rejects, more accurate test results
- Temperature control on heating circuits
- Longer life of electric equipment; a reduction of overheating and burnouts; the protection of precision tools, electronic tubes, and delicate instruments
- Kva demand reduced, power factor improved, increased circuit loadability and, often, reduced power cost

GOOD voltage is no longer a luxury. It is now easy and inexpensive to extend the benefits of good voltage to every nook and corner of your plant—benefits that quickly pay for the small initial cost of equipment.

By good voltage we mean voltage that is neither too high, nor too low, nor extremely variable. A 10 per-cent *overvoltage* reduces incandescent-lamp life 75 per cent, decreases the power factor of general-purpose motors from 3 points at full load to 5 and 6 points at half load, and causes overheating in various potential devices. A 10 per-cent *undervoltage* decreases the light output of incandescent lamps approximately 30 per cent, increases the temperature rise of general-purpose motors 6 to 7 degrees C, reduces their torque and overload capacity approximately 19 per cent, cuts the output of a typical heating oven from 1500 to 1275 pounds per hour. Studies of the effect of poor voltage on other electric equipment show similar losses.

If you suspect poor voltage of being the cause of pepless motors, poor lighting, or production slumps at your plant, we'll be glad to help you make a system study. This will determine what corrective measures are necessary. Remember that whether you need voltage regulation for your plant as a whole, for your laboratory, for a vacuum tube, or a power shovel there is a simple, economical G-E device for the job. *General Electric, Schenectady 5, N. Y.*

GENERAL ELECTRIC

De Laval Labyrinth Wearing Rings contribute in a large measure to sustaining the high efficiency of De Laval pumps. The large clearance, tortuous labyrinth passage reduces leakage to a minimum and maintains ample running clearances under all conditions.

For sustained efficiency and reduced maintenance costs look for De Laval Labyrinth Wearing Rings when buying centrifugal pumps.

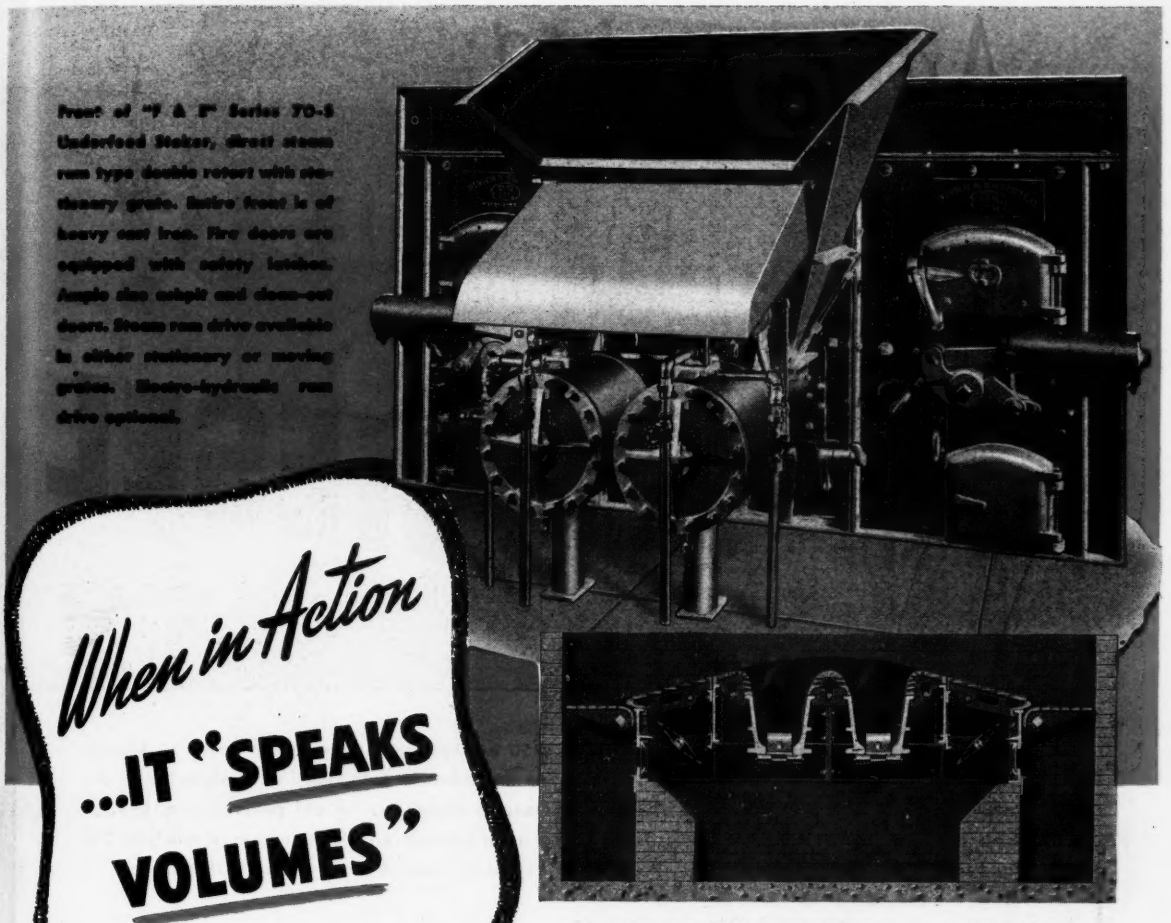
3235

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA • BOSTON • CHARLOTTE • CHICAGO • CLEVELAND • DENVER DETROIT • DULUTH • EDMONTON • GREAT FALLS • HAVANA • HELENA • HOUSTON KANSAS CITY • LOS ANGELES • MONTREAL NEW ORLEANS • NEW YORK • PHILADELPHIA PITTSBURGH • ROCHESTER • ST. PAUL • SALT LAKE CITY • SAN FRANCISCO • SEATTLE TORONTO • TULSA • VANCOUVER • WASHINGTON, D. C. • WINNIPEG



Front of "F & E" Series 70-S Underfeed Stoker, direct steam ram type double retort with stationary grate. Entire front is of heavy cast iron. Fire doors are equipped with safety latches. Ample size ashpit and clean-out doors. Steam ram drive available in either stationary or moving grates. Electro-hydraulic ram drive optional.

When in Action ...IT "SPEAKS VOLUMES"

Cross-section of double retort stationary grate stoker, equipped with "F & E" air zoned windbox. Close spacing of the bearing bars gives rigid and durable construction. All "F & E" tuyeres and grates are made of heat-resisting metals and designed to deliver air to fuel bed in correct proportions and pressures.

Teamed up with boilers called upon to produce 25,000 to 40,000 pounds of steam per hour, the "F & E" Series 70-S, double retort Underfeed Stoker, with built-in reserve ruggedness, settles down to a tireless, steady pace, delivering steam-power in uninterrupted, dependable volume.

The steam drive of "F & E" 70-S, simple, direct and economical, operates the ram by steam direct from boiler, eliminating all intermediate driving equipment. The "F & E" patented automatic Interval Timer Governor makes possible *that full stroke, full speed ram action* at any coal feeding rate, a proved essential to efficient fuel burning.

Only in "F & E" Stokers are found the combination of six engineered features that dove-tail into an accurate firing mechanism, resulting in a concentrated self-contained assembly.

Check with your consulting engineer or local "F & E" Representative on "F & E" Series 70-S Stoker applications with industrial boilers in prominent plants and large buildings.

FLYNN & EMRICH CO.

Established 1842

HOLLIDAY & SARATOGA STREETS, BALTIMORE 2, MARYLAND

Representatives in Principal Cities

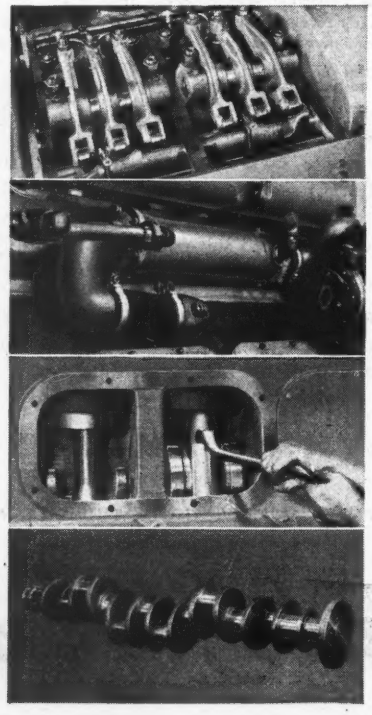
F&E Underfeed Stokers

HYDRAULIC DRIVE AND STEAM DRIVE FOR BOILERS PRODUCING 10,000 TO 40,000 LBS. OF STEAM PER HOUR

Announcing:

THE NEW SERIES 20 HENDY DIESEL

NOW in the 190 to 250 horsepower range—Hendy Series 20 Diesels bring new standards of dependability and economy to the industrial field. They are designed from the owner's viewpoint entirely—no concessions were made in design, use of old patterns, practices, or tooling. Consequently, Series 20 Diesels have features never before available in engines of this size. The industrial users of Diesel power can *now* obtain the very latest in tested Diesel-engine performance.



REDUCED MAINTENANCE:

Unit fuel pumps and injectors and the overhead camshaft eliminate all high-pressure fuel lines and many moving parts. Air-starting valves, intake and exhaust valves, and fuel injectors and pumps are actuated by rocker arms bearing directly on the overhead camshaft. Inspection and adjustments of valves and injection system can be made by removal of cylinder-head covers.

EFFICIENT OPERATION:

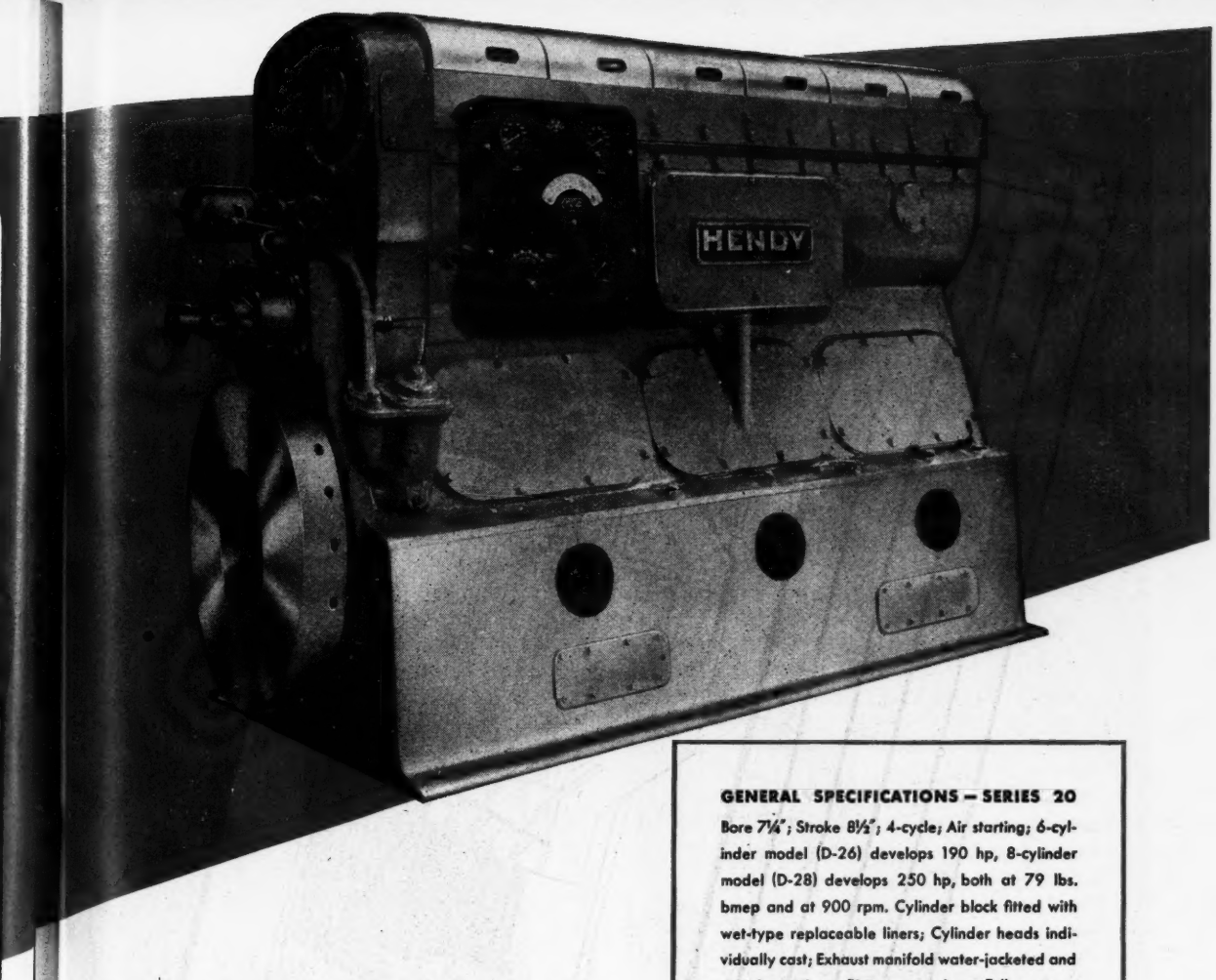
Full pressure lubrication to moving parts provides correct lubrication at all times. An integral oil-cooler keeps the oil at an efficient operating temperature. Uniform cylinder and head temperatures are assured by high velocity, controlled flow of the cooling water and the advanced design of the water jackets.

EASY SERVICING:

Fuel-oil filters, lube-oil conditioners, and fuel-transfer and lube-oil pumps are conveniently located for easy and quick servicing. Each can be removed without disturbing other assemblies. Unit fuel pumps and injectors can also be easily removed for inspection or service. Main and crankpin bearings are readily accessible by quickly removing the large hand-hole plates...without disturbing any other assembly.

LONGER LIFE:

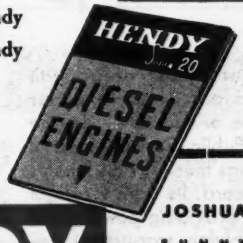
The crankshaft is dynamically balanced, to minimize vibration at *all* speeds, and is large and well proportioned to assure long life and smooth operation. All bearing surfaces receive positive pressure lubrication. The crankshaft is supported by large, replaceable, bronze-backed bearings.



GENERAL SPECIFICATIONS — SERIES 20

Bore 7¼"; Stroke 8½"; 4-cycle; Air starting; 6-cylinder model (D-26) develops 190 hp, 8-cylinder model (D-28) develops 250 hp, both at 79 lbs. bmep and at 900 rpm. Cylinder block fitted with wet-type replaceable liners; Cylinder heads individually cast; Exhaust manifold water-jacketed and cast in sections; Pistons, cast iron; Full pressure lubrication to moving parts, with oil cooled and filtered before entering distribution manifold. Optional equipment includes: closed-circuit cooling systems; clutch power take-offs from either end; belt-driven starting-air compressor. Also available as complete electric generating plants.

Diesel-power users will appreciate many important features in addition to those listed at the left. These new engines were designed specifically to meet the most rigid tests for economy and maximum dependability. And, what is equally important, they are built by skilled mechanics in plants unusually well equipped with modern, precision machine tools that take full advantage of production-line methods. Other Hendy Diesels available up to 800 horsepower. Joshua Hendy Iron Works, Sunnyvale, California.



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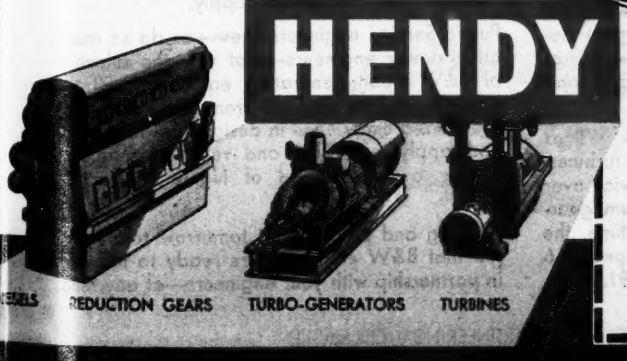

JOSHUA **HENDY** IRON WORKS
ESTABLISHED 1856
SUNNYVALE, CALIFORNIA

Please send me complete details on Hendy Series 20 Stationary Diesel engines ☐. Hendy Series 20 Diesel-generator sets ☐.

Name_____ Position_____

Company _____

Street_____

City_____ Zone____ State_____

94-D-18

GIVING EXTR

Six B&W 550,000 lb. per hour Radiant Boilers of this design are performing notably at Burlington and Marion Generating Stations of Public Service Electric and Gas Company.

In New Jersey's critical war-plant areas, with their enormously increased load demands, power has never been "too little or too late." To the Electric Department of Public Service Electric and Gas Company belongs much credit for this distinguished war-time record. Its keen foresight and sound engineering in providing power-plant facilities capable of supplying war-urgent demands far beyond expectations are well illustrated by the performance of the Burlington and Marion Generating Stations.

In these two stations six Babcock & Wilcox Radiant boilers serve three 125,000-kw turbines, the first two boilers having been in service over 4½ years. Operating at their maximum guaranteed continuous rating most of the time, the load factor for the six boilers has averaged 81.6 per cent, and the availability factor 91.4 per cent, for a total of twenty boiler years.

These boilers have never suffered a decrease in capacity caused by slag troubles, even though they have burned low ash-fusion coals from three states and *many* different mines—coals entirely different from the normal supply.

Public Service engineers knew—as do so many other power engineers—that with the selection of B&W steam-generating equipment, all the advantages are realized from over 60 years' specialized experience in designing, fabricating, and applying boilers and related equipment having a long record of highly satisfactory service.

Thinking and planning for tomorrow *today* is a job that B&W engineers are ready to tackle—in partnership with your engineers—at any time.

SERVICE..AT PUBLIC SERVICE

Burlington Generating Station where four B&W Radiant Boilers are supplying over 2,000,000 pounds of steam per hour.

B&W

BABCOCK & WILCOX

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET, NEW YORK 6, N.Y.

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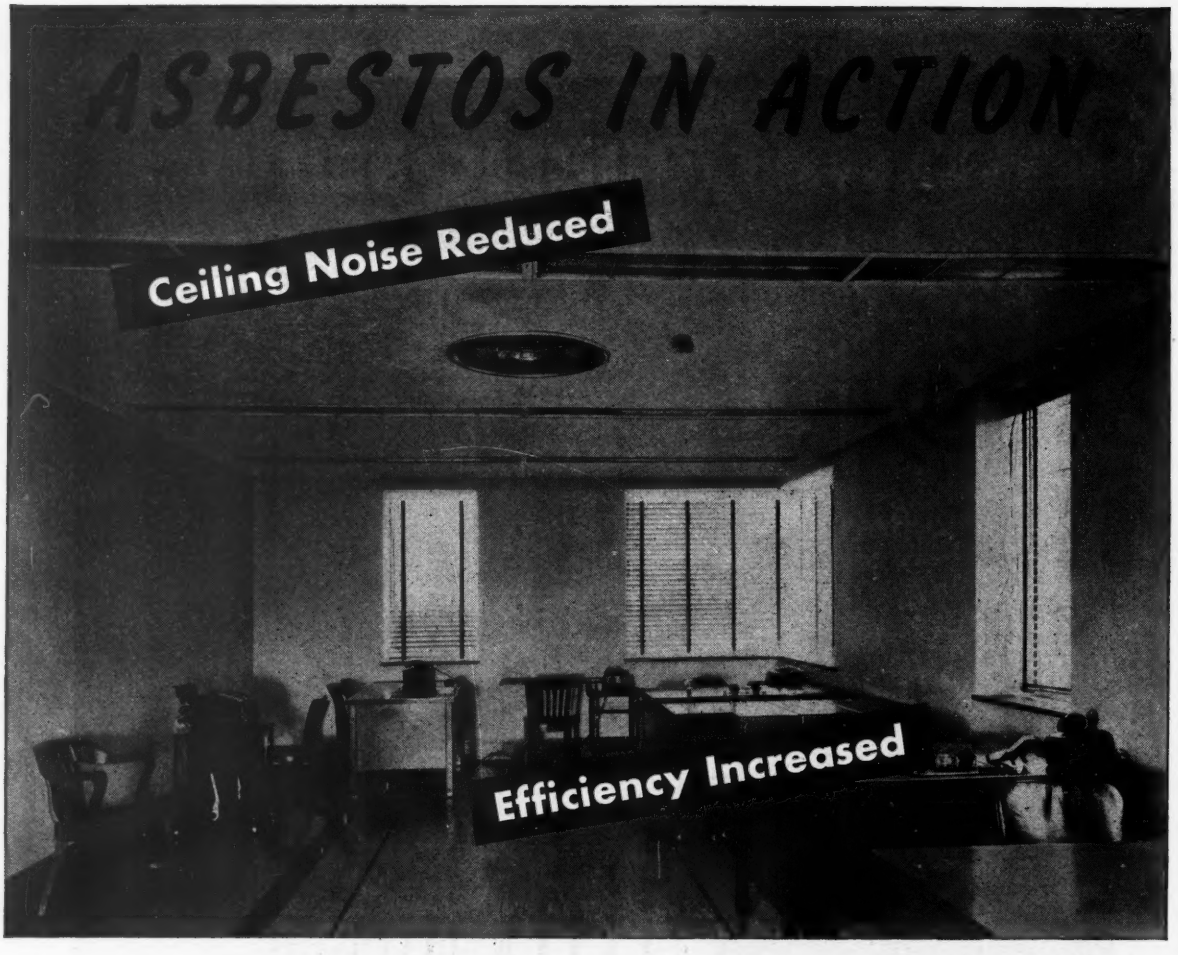

Office acoustical problem solved by K&M Sprayed "Limpet" Asbestos

Three and a half years ago a "gun" sprayed a sound absorbing material on the ceiling of this office. Nerve-jangling noises were reduced by 70%. The efficiency of the entire office immediately increased.

This material was K&M Sprayed "Limpet" Asbestos, which, by its porosity, absorbs sound . . . by its diaphragmatic action, reduces it still further. This amazingly adaptable material goes on the most intricate architectural design as easily as plaster. It is ideal for acoustical treatment in laboratories, offices, engine-testing rooms —any place where working conditions can be improved by noise reduction.

Here are some of the advantages of K&M Sprayed "Limpet" Asbestos:

No cutting or fitting—completely covers, completely insulates—no seams, no joints, no holes. Easily applied—sticks tight to any clean surface regardless of shape or composition.

High noise reduction coefficient of .70 for a ¾" thickness.

Fire-resistant and heat-insulating—thermal conductivity .31 at 75° F.

Surface may be covered with as many as 10 coats of oil emulsion paint without seriously impairing efficiency.

ARMY E NAVY
K&M
best in asbestos

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

Tougher tubes take the air

Tube failure occurred after 6 months' service in the inlet sections of main and auxiliary condensers of a turbine-driven Pacific Coast ship. Non-metallic inserts had been installed when severe inlet corrosion was observed. This early difficulty was followed by failure. Scovill was called in.

Laboratory examination disclosed a light brown protective film in irregular bands inside the tubes. Elsewhere severe pitting and thinning of the tube wall was found. The pits, irregular in shape, showed elongated tails in the direction of flow.

IRREGULAR ATTACK POINTS TO CURE

Searching further, the Scovill men found evidences of mechanical abrasion and erosion of the protective coating attributable to high velocity of the circulating medium containing entrained air. Non-metallic inserts had protected the tubes from inlet end erosion, but erosion-corrosion was found to be general throughout the length of the tubes.

The units were retubed with 70/30 Cupro-Nickel and no further failures were reported. Erosion-corrosion can often be minimized by preventing air leakage in circulating water and by eliminating turbulence and low pressure areas where dissolved gases can separate.

OTHER SCOVILL SERVICES

In addition to *Service in Men*, which includes assistance with installation problems and specialized advice on tube specifications, Scovill offers two additional services.

Service in Metals undertakes the selection of alloys and the study of specific problems both in the field and in the laboratory.

Service in Manuals offers valuable literature on condenser and heat exchanger tubes. Write for your copy of our Condenser Tube Booklet. Address Scovill Manufacturing Company, 17 Mill Street, Waterbury 91, Conn.

Scovill
MANUFACTURING COMPANY
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CONDENSER TUBES
ONE PRODUCT . . . THREE SERVICES
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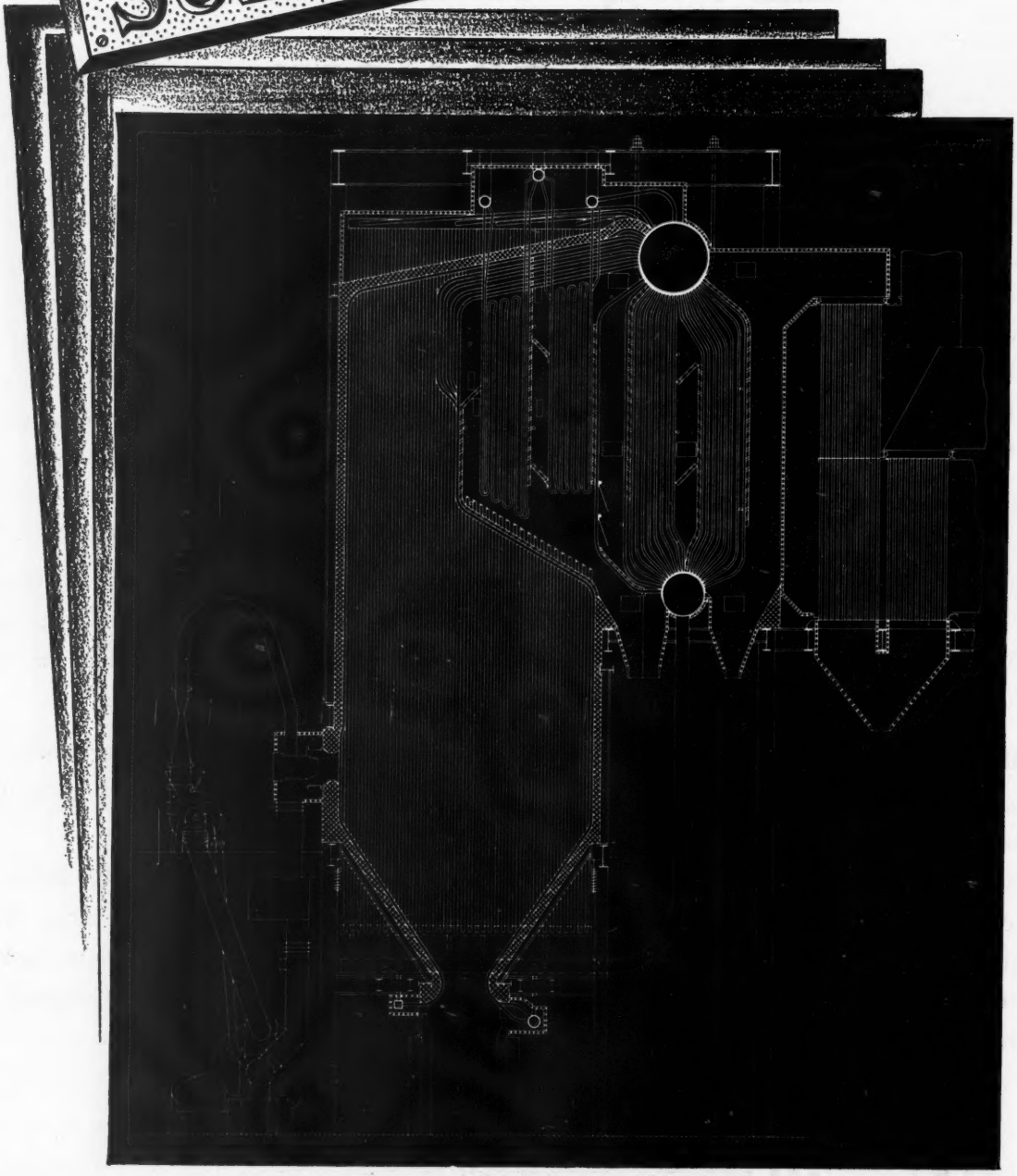
SUPERIOR STEAM



Steam generators for New Bedford Gas & Edison Light Company and Staten Island Edison Corporation

FW FOSTER

GENERATOR DESIGN

FOR

New Bedford and *Staten Island*

FOUR new steam generators each designed for 120,000 lb. per hr. at 950 lb. sq. in. and 910° F. final steam temperature.

STEAM GENERATION

Large Central Station steam generator design applied to medium capacity units.

High furnace—long flame travel—cool exit gases—minimum tendency to slag.

Control of final steam temperature from 60 per cent to full load.

Ample circulation head.

Exceptional accessibility of pressure parts.

PULVERIZED FUEL FIRING

Sustained efficiency due to fine pulverization.

Ability to handle low grade, wet coal.

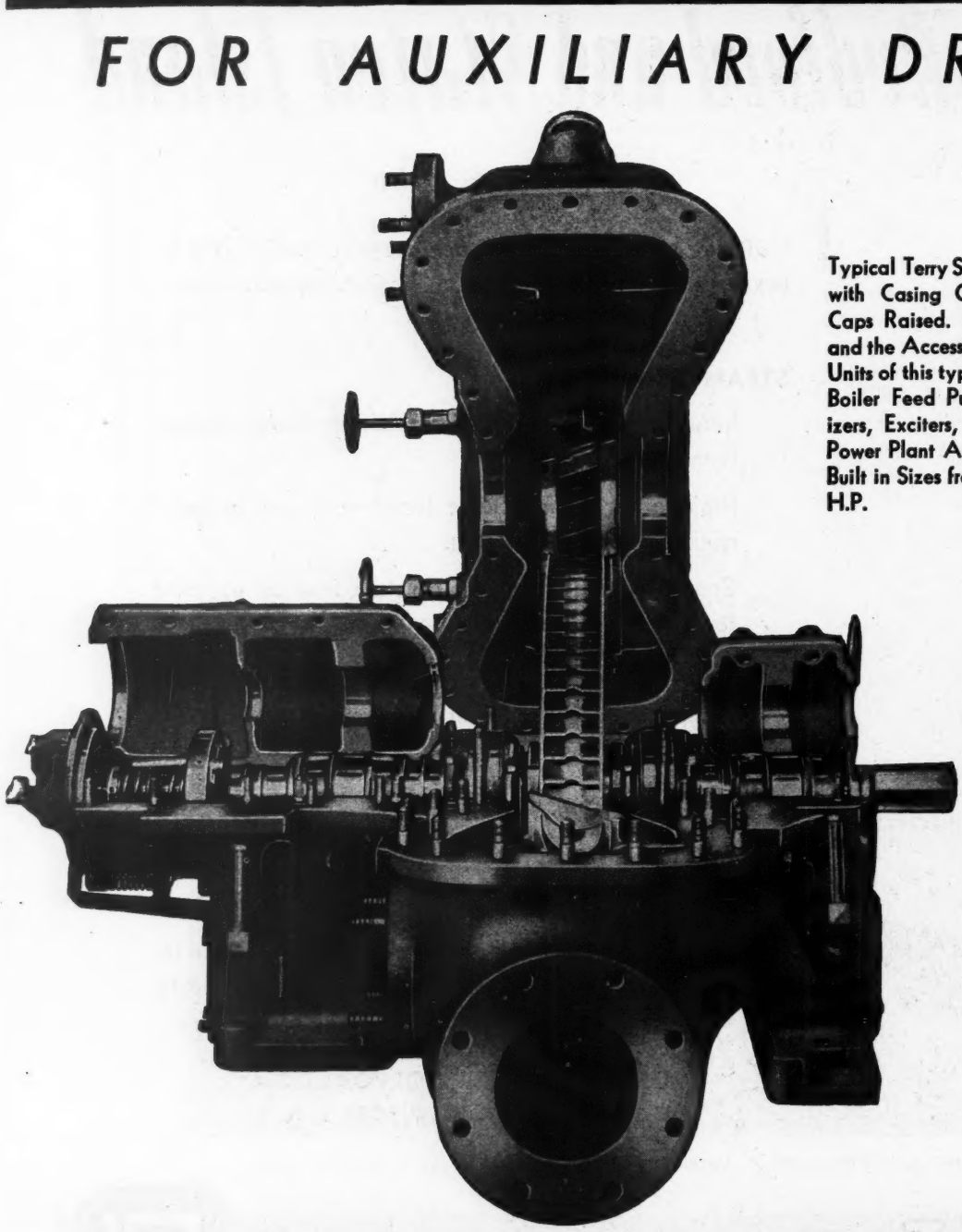
Surplus pulverized fuel always available for sudden increases in load or temporary plugging of coal supply.

FOSTER WHEELER CORPORATION
165 BROADWAY • NEW YORK 6, N. Y.

WHEELER

The TERRY

FOR AUXILIARY DRIVE



Typical Terry Solid Wheel Turbine with Casing Cover and Bearing Caps Raised. Note Ruggedness and the Accessibility of All Parts. Units of this type are used to drive Boiler Feed Pumps, Coal Pulverizers, Exciters, and All Types of Power Plant Auxiliary Equipment Built in Sizes from 5 H.P. to 2000 H.P.

THE TERRY STEAM TURBINE CO.

Wheel Turbine

E OFFERS MANY ADVANTAGES

FROM THE SMALLEST TO THE LARGEST, THESE RELIABLE TURBINES HAVE —

- Indestructible One Piece Wheel
- Large Radial and Axial Clearance
- Double Rim Protected Blading
- Dependable and Durable Governor
- Heavy Dust-Proof Bearing and Governor Housing
- Independent Overspeed Trip with Separate Valve
- Sturdy Casing Design
- Strong and Easily Inspected Steam Strainer
- Sight Oil Level Gauges
- Individual Nozzle Control
- Truly Accessible Construction, Which Makes Inspection of the Interior Parts a Simple Matter

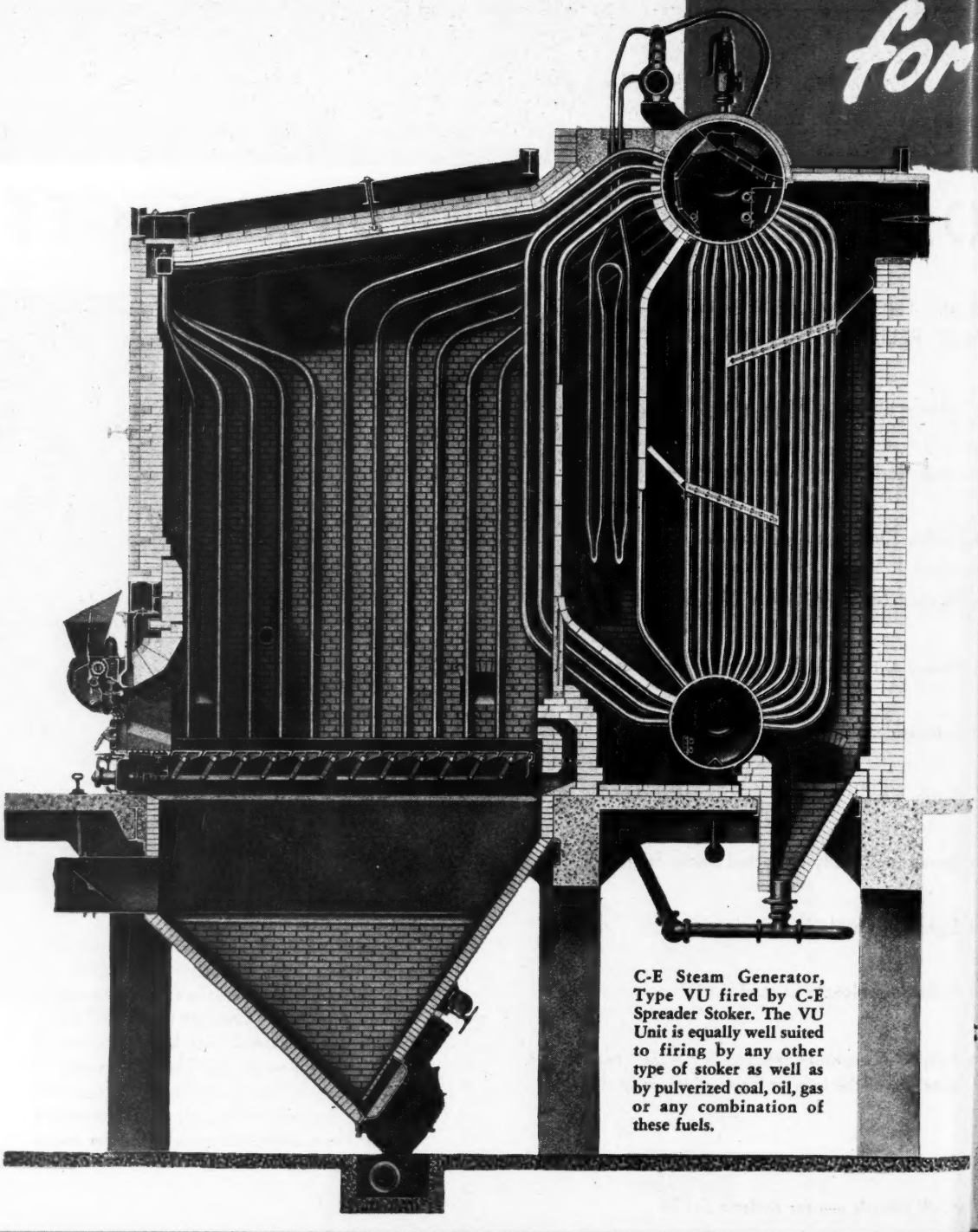
Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

For Full Details ask for Bulletin S-116

T-1144

TERRY SQUARE - HARTFORD, CONN.

for



C-E Steam Generator, Type VU fired by C-E Spreader Stoker. The VU Unit is equally well suited to firing by any other type of stoker as well as by pulverized coal, oil, gas or any combination of these fuels.

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEA

HUNDREDS OF PLANTS

this combination of boiler and stoker

is the right answer

When we say hundreds of plants we mean it literally for there's no combination of equipment in the whole C-E line, from 30 hp HRT boilers to million-lb per hr units, that is so well adapted to a wide range of conditions and requirements.

The C-E Spreader Stoker will burn satisfactorily the high ash, high volatile coals of the Pacific Coast region, the sub-bituminous coals and lignite of the West, the free-burning clinkering midwestern coals of Illinois, Indiana, Ohio and Western Kentucky and the caking bituminous coals of the East. Poor quality, fine sizing and other undesirable characteristics are all taken in stride by the C-E Spreader — the nearest thing there is to a universal stoker. With a furnace design properly adapted to the requirements of spreader firing, as it is in Combustion's VU Unit, advantage can be taken of whatever low-priced coals the market affords.

The VU Unit as a whole was initially designed to bring central station performance standards to the average plant. That it met this objective is now a matter of record in hundreds of installations. The quality of its design and construction is perhaps best evidenced by its ability to stay on the line for long periods of uninterrupted service. Translated into economic terms, this means maximum protection against direct and indirect outage losses which in many plants can easily be of substantial proportions. It also means low year-in and year-out maintenance. Coupled with the high efficiency characteristic of VU performance, these advantages add up to low overall steam costs, or, to put it another way, high return on investment.

Installations of this VU — Spreader Stoker combination now have an aggregate capacity of more than 2,500,000 lb of steam per hr. Units ranging in capacity from 20,000 to 100,000 lb per hr are in use in a wide variety of processing and manufacturing industries not only throughout the United States but in South America and in such remote regions as Russia and China. Their performance records are your assurance of efficient, dependable operation.

So, unless *your* steam plant is all that it should be — modern, efficient, reliable *and* able to cope with almost any fuel situation — it is not too early to plan its rehabilitation. As a first step, why not investigate the C-E Spreader fired VU Unit?

A-8m

ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.

Specify ERNST SAFETY WATER COLUMNS
FOR *Better* VISIBILITY

ON LAND — USED ALL OVER THE WORLD — AND SEA

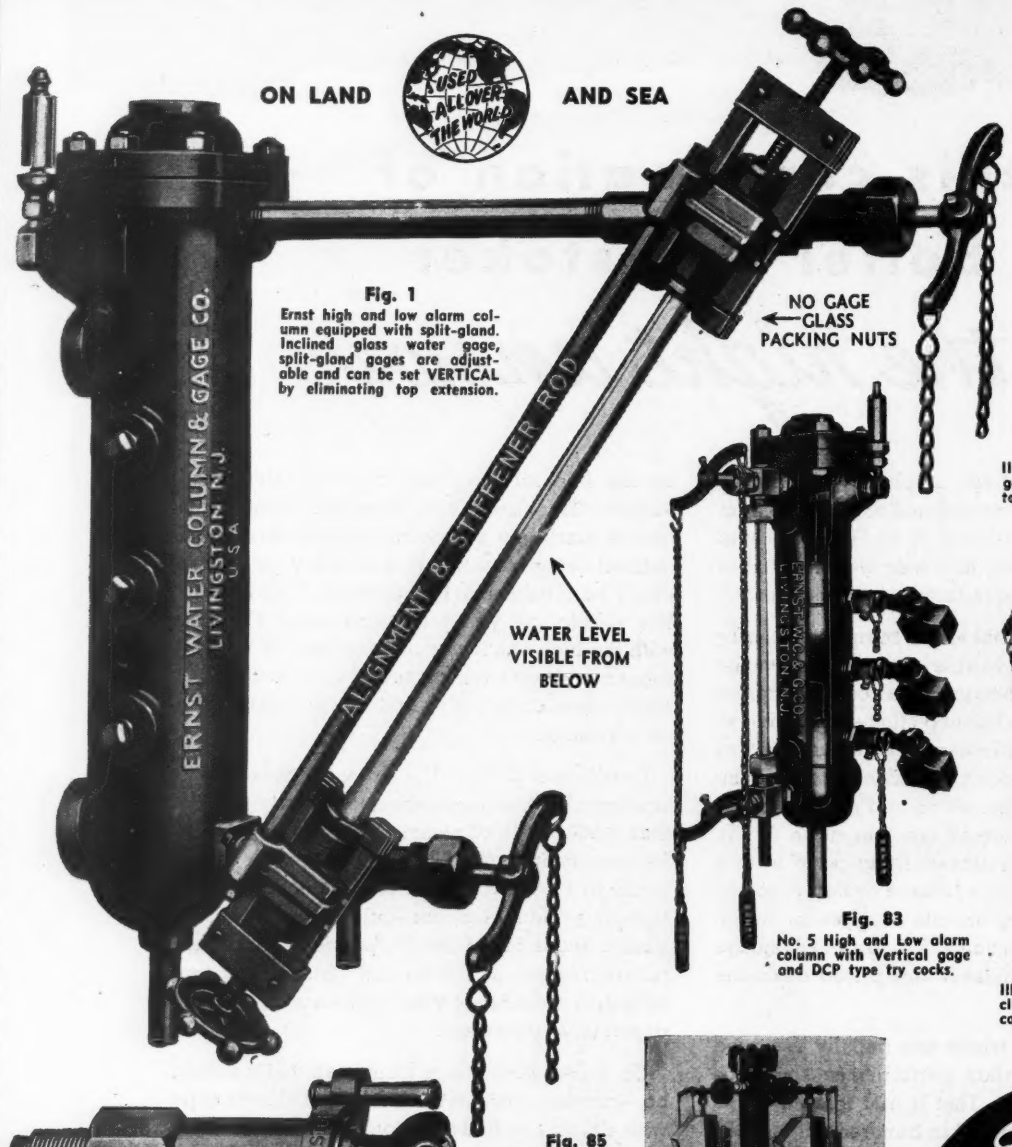


Fig. 1
Ernst high and low alarm column equipped with split-gland. Inclined glass water gage, split-gland gages are adjustable and can be set VERTICAL by eliminating top extension.

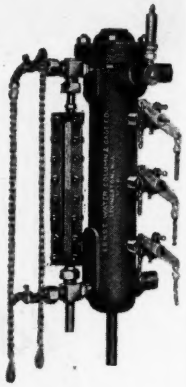


Fig. 30
Illustrates Vertical prismatic wat gage. Steam shows WHITE and w ter shows BLACK.

Fig. 83
No. 5 High and Low alarm column with Vertical gage and DCP type try cocks.

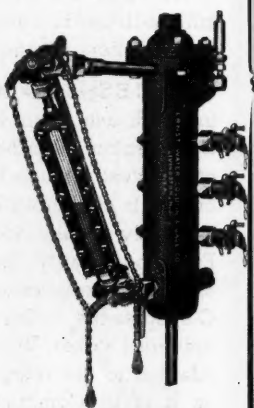


Fig. 32
Illustrates Standard Adjustable In clined prismatic gage attached t column, also super leakless try cocks

Fig. 13
LEAKLESS COCKS, Bronze and Forged steel construction.

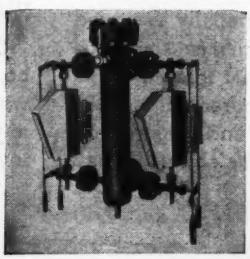


Fig. 85
Ernst Two-Gage High and Low alarm column with direct Vision Hoods and C-Clear thru Inserts for pressures up to 900 pounds.

GIVE THE FOLLOWING INFORMATION

FIG. NO..... BOILER PRESSURE.....Pounds

Size of Steam and Water Connections.....Inch Screw or Flange.....

Size of Water Gage Fittings.....Screwed Spaced at....." Centers

or Send Detailed Sketch with Specifications

SPECIAL COLUMNS MADE TO ORDER — GIVE FULL DETAIL OF YOUR REQUIREMENTS

Ernst
STANDARD COLUMNS FOR PRESSURES UP TO 900 LBS.
SPECIAL COLUMNS FOR HIGHER PRESSURES

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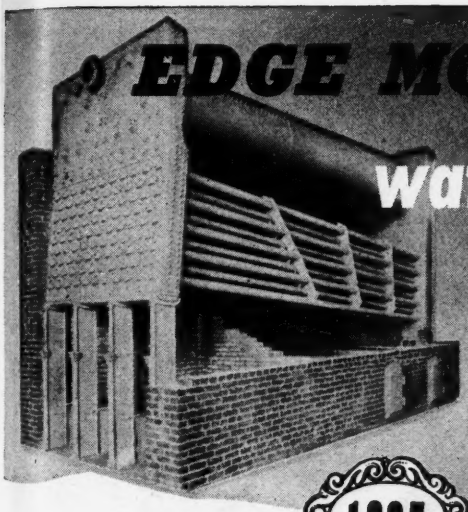
EDGE MOOR
water tube boilers



VINTAGE 1895 • THE FIRST EDGE MOOR WATER TUBE BOILER

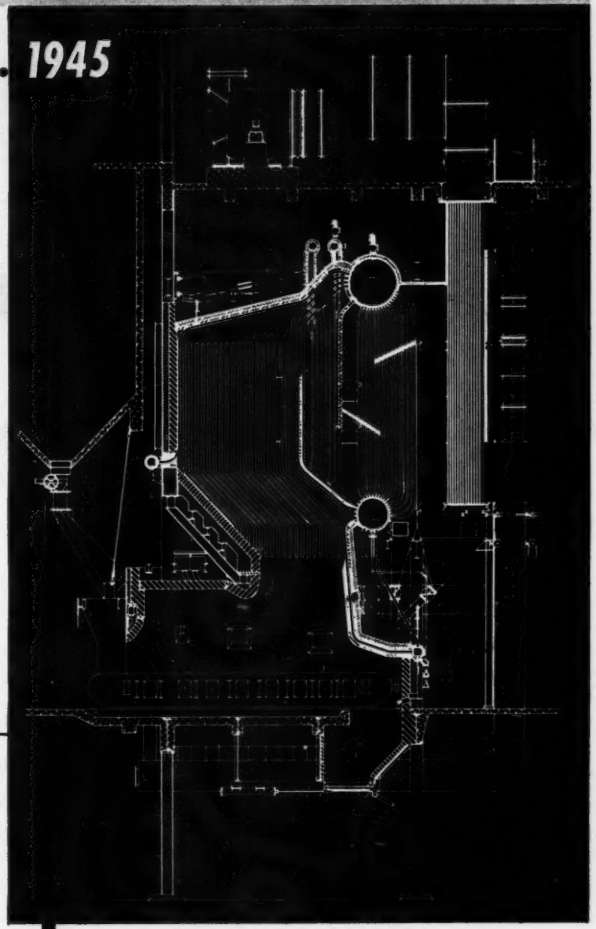
An Edge Moor Catalog of 1902 states: "This boiler is still in active service, and demonstrates that our boilers were designed on sound principles, and only improvements in details were necessary to make them what they are today."

1895 1945

Edge Moor was established in 1868 and has been building steam generating units for nearly three-quarters of a century. Fifty years ago, in 1895, we began the manufacture of water tube boilers, and followed several years later with the first superheating steam boilers.

Edge Moor engineers have continued to contribute to the store of knowledge and experience gained in the building of steam generating equipment. Today, upwards of 5000 installations attest to the many advances in design, efficiency and standards of quality originated by Edge Moor.

Edge Moor boilers are designed for any required capacity and up to 900 lbs drum pressure. Complete steam generating units, auxiliary equipment and installation service are available—from Edge Moor.



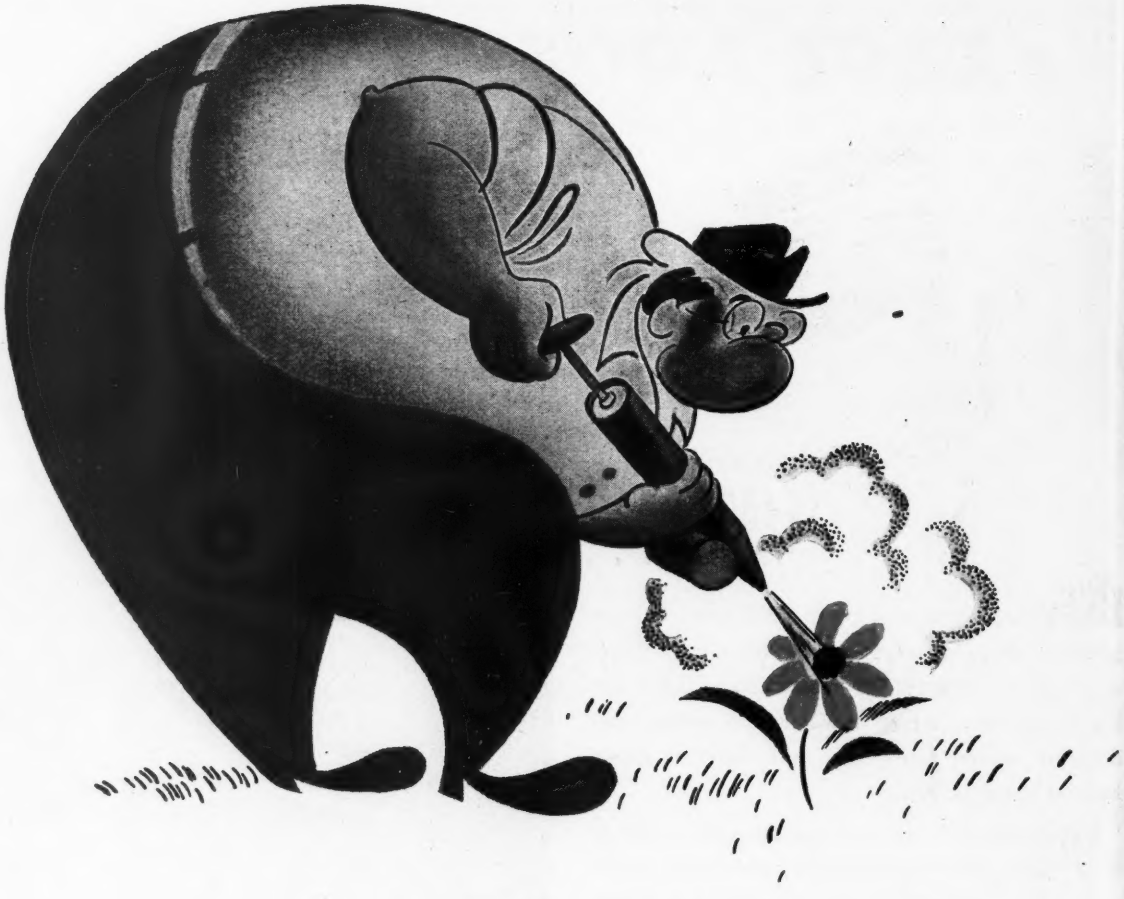
Edge Moor 2-drum bent tube boiler with pendant convection superheater, vertical tubular air preheater, water cooled furnace, traveling grate stoker. Capacity, 75,000 lbs steam per hour; Drum Pressure, 450 psi; Degrees of Superheat, 300; Final Steam Temperature, 750° F.

STEAM GENERATING EQUIPMENT

EDGE MOOR IRON WORKS, INC.

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

MAIN OFFICE AND WORKS: EDGE MOOR, DELAWARE



SPRAY PROTECTION

Life saver? Sure! And that's exactly what spray protection means to the rotor shaft of every Westinghouse Type C Turbine. A generous coating of corrosion-resisting steel is sprayed on at the gland zones to prevent shaft rusting after long shutdowns . . . providing insurance against excessive gland leakage and oil contamination.

Shaft protection is just *one* of the many plus values that make these Westinghouse general-purpose mechanical drives the "most turbine for your money". When you buy a Type C, you get extra reliability, extra safety, extra economy in operation—and the use of steam drives may improve the heat balance of your entire plant.

Westinghouse Type C Turbines are built in five different sizes, covering a range of 5 to 1500 hp. The long list of proved-in-service installations includes pumps, forced and induced draft fans, pulverizers, compressors, Jordans, pulp beaters, line shafts, generators—and many other applications where steam drives are used to improve over-all heat balance. For complete information call your nearest Westinghouse representative. Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Penna.

J-50459

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

STOPS SHAFT RUST

ON WESTINGHOUSE TYPE C TURBINES

High chrome-nickel steel is sprayed on at the two gland zones of every Westinghouse Type C Turbine shaft. To prove a permanent anchor for the sprayed metal, the shaft is grooved, undercut and knurled. Then the metal, fed from a wire roll, is applied with an oxyacetylene torch. After spraying, the entire shaft is finish-ground.

This Westinghouse shaft-spraying process is an important hidden value of the Type C Turbine. Rust protection prevents excessive steam leakage and oil contamination resulting from rust-cut carbon gland segments.

Steam Headquarters

WESTINGHOUSE

ACCURATE FLOW MEASUREMENT at LOW COST THE SIMPLEX MS METER

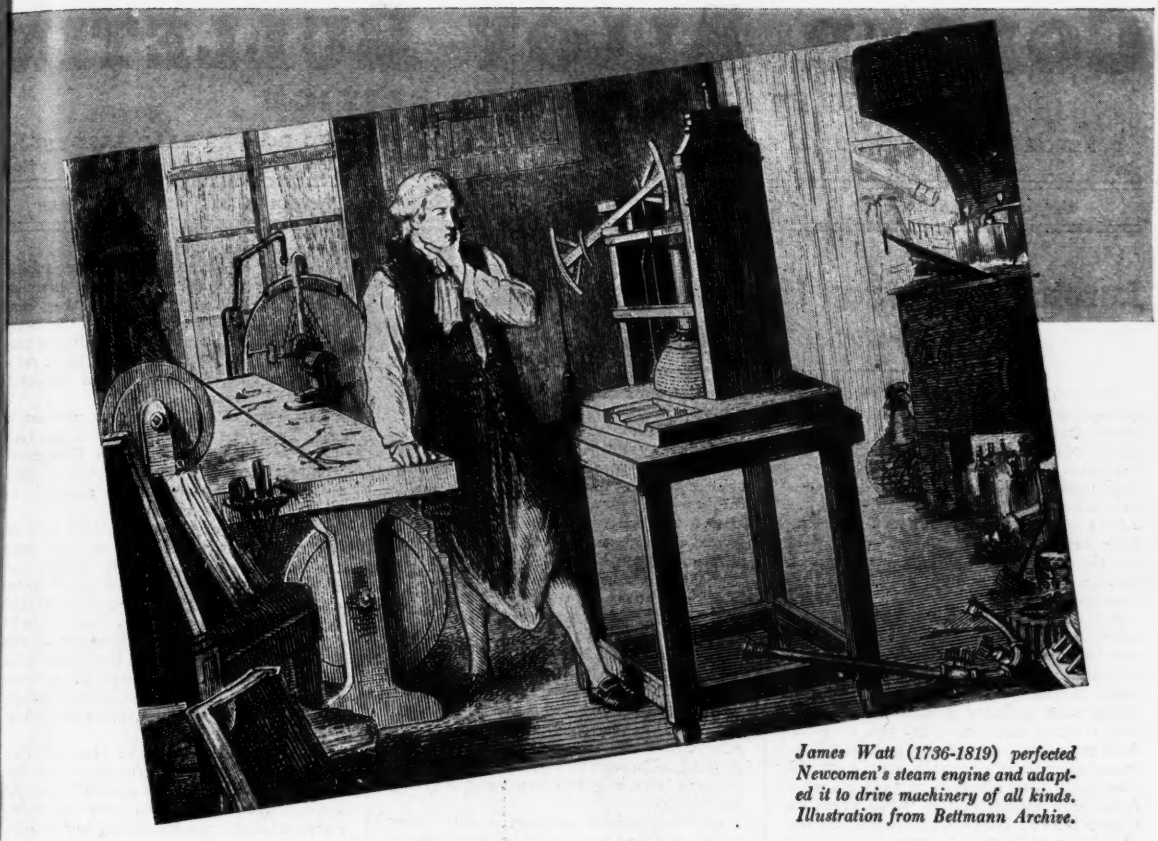
This low cost Simplex instrument meets the high standards for accuracy, sensitivity and dependability required in measuring flow rates in water and sewage, as well as in power and process plants.

These are some of the advantages of the Simplex MS Meter:

1. Operates efficiently with any suitable primary device.
2. Is installed and maintained economically.
3. Rugged, trouble-free construction.
4. Accuracy over entire flow range.
5. Simplex bell-shaped float which translates the half power of the differential into uniform graduations of chart and dial.
6. Direct reading totalizer of the 7 digit type.

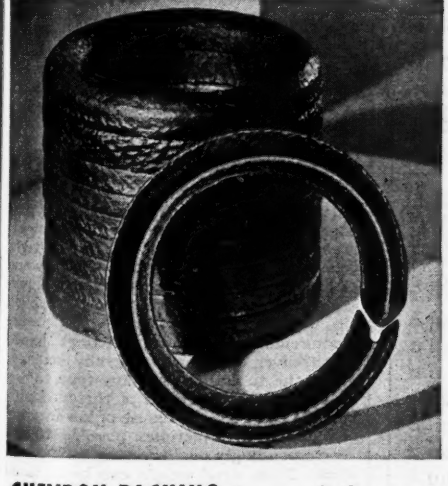
Complete data is now available in Bulletin 350 — straight-forward, factual information with drawings, charts, and test data. Write for your copy today — specify the Simplex MS Meter in tomorrow's planning.

SIMPLEX VALVE & METER CO.
6783 UPLAND STREET, PHILADELPHIA 42, PENNA.



James Watt (1736-1819) perfected Newcomen's steam engine and adapted it to drive machinery of all kinds. Illustration from Bettmann Archive.

JAMES WATT Perfected the Steam Engine in 1781



CHEVRON PACKING is one of the many Garlock quality-controlled packings. The unique hinge-like design allows the packing to expand and contract—it adjusts itself automatically to variations in pressure.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada, Ltd., Montreal, Que.

"One Sunday morning" wrote James Watt, "the idea occurred to me that steam would expand and rush into a vacuum." At that moment the modern steam engine was born in Watt's brain—a flash of genius for which all mankind is thankful.

About the time steam engines came into general use nearly a century later, Garlock began manufacturing packings to improve their operation—and today Garlock supplies packings and gaskets for millions of engines now in use throughout the world.

Garlock

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Duronze IV Proven Ideal for Seaboard Power Plant Condenser Tubes

Accumulated performance records of Bridgeport's DURONZE IV in seaboard power stations, since this alloy was first made commercially available by the Bridgeport Brass Company, have definitely confirmed its superiority to other condenser tube alloys for this service. Although the merits of the DURONZE IV type of alloy have been known for many years, only experimental quantities had been produced because of the difficulties involved in its manufacture.

Condenser installations on polluted estuaries and harbors have long been recognized as presenting one of the most complex corrosion problems encountered in power plant practice. The mixing of tidal salt water with polluted fresh water, which may contain acid waste, sewage, and cinders introduces conditions that result in extremely severe corrosive attack on the commonly used alloys such as Admiralty, Aluminum Brass, and in some cases on Cupro Nickel. However, through the use of modern casting techniques and the use of more powerful mill equipment, Bridgeport was able to solve this corrosion problem for marine power plants by the commercial production of DURONZE IV. Today DURONZE IV is classed as one of the standard condenser tube alloys. Its composition is Copper 93.5% min., Aluminum 5% min., Arsenic 0.3% max.

For reasons of utility company policy, some of the more important recent applications of DURONZE IV in seaboard power stations may not be described. Proof, however, of the superiority of the DURONZE IV type of alloy to other condenser tube alloys for brackish water corrosion is well illustrated by the remarkable performance record of an experimental installation of about 5000 tubes which were put into a seaboard condenser in 1913. These tubes had outlived their usefulness in 1942—after 29 years of service in which only minor replacements were made. In the same power plant, two adjacent condensers of identical design had been using Admiralty condenser tubes whose life averaged six years.

In another seaboard power plant where Admiralty lasts from 2½ to 3 years, and Aluminum Brass 4 to 5 years, DURONZE IV has now been in over 6 years and is giving fine service.

Another serious problem in salt water power stations as well as in other plants using steam turbines which depend on a condenser that produces a high vacuum and calls for higher velocities of circulating water is "corrosion-erosion" caused by impingement of air bubbles on the condenser tube wall. When an impinging stream of water containing air and other entrained gases attacks and wears through the protective film of a plain brass condenser tube it gains access to the underlying layer of metal. The impinging stream then continues to aid in the removal of the metal since it cannot continue to produce a protective film in this particular spot. As a result, typical almond shaped undercut pits and holes are developed.

Bridgeport's answer to this problem is again DURONZE IV, which resists this type of corrosion exceptionally well. Bridgeport produces other impingement corrosion resisting alloys, which are superior to Admiralty in this respect.

Power Plant engineers, who will at some future time be considering retubing their condensers, would do well to try out sample lots of DURONZE IV tubes under actual service conditions. By the time that they are ready for retubing, they will be in a position to know what DURONZE IV can do for them in extending condenser tube life. In some cases DURONZE IV, because it remains cleaner than some other alloys, will permit greater efficiency as far as heat transfer is concerned.

All indications point to the fact that future demands for electric power will continue to grow because of greater use in the home, rural electrification, new industries, transportation, the increasing use of automatic industrial equipment powered by electricity, and many other factors. Operators must be prepared to keep their plants at top notch efficiency, with a minimum of shutdowns and maintenance problems.

Much data on DURONZE IV and other Bridgeport alloys and results of many years of corrosion research are published in Bridgeport's 112-page Condenser Tube Manual. Be sure to write for a copy using company stationery. Also, why not get acquainted with our nearest technical adviser who can help you increase condenser tube life.

Compositions and Specifications — Condenser and Heat Exchanger Tubes

Alloy	Composition % Copper	% Tin	% Aluminum	% Nickel	% Lead	% Iron	% Zinc	% Manganese	% Arsenic	Specifications A.S.T.M.
Admiralty Type "A"	70.0 min.	0.90-1.20			0.075 max.	0.06 max.	Remainder			*B111-43 Type "A"
Admiralty Type "B"	70.0 min.	0.90-1.20			0.075 max.	0.06	Remainder		0.10 max.	B111-43 Type "B"
Cuzinal (Alum. Brass) Type "B"	76.0 min.		1.75 min.		0.075 max.	0.06 max.	Remainder		0.10 max.	B111-43 Type "B"
Duronze IV	93.5 min.		5.0 min.						0.30 max.	B111-43
Muntz Metal	59.0-63.0				0.30 max.	0.07 max.	Remainder			B111-43
Red Brass	84.0 min.				0.75 max.	0.06 max.	Remainder			B111-43
*70-30 Cupro Nickel	Remainder	1.20 max.		29.0-32.0	0.05 max.	0.5 max.	1.0 max.	1.0 max.		*B111-43
80-20 Cupro Nickel	Remainder	1.0 max.		19.0-23.0	0.05 max.	0.5 max.	1.0 max.	1.0 max.		B111-43
Arsenical Copper	99.45 min.								0.15-0.50	B111-43
Copper	99.90 min.				Phosphorus 0.035 max.					B111-43

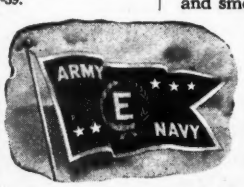
*Also meets Federal Spec. WW-T-656 and Navy Spec. 44T7f.

*Specifications for 70-30 Cupro Nickel are under revision and will probably show minimum and maximum values for manganese and iron that will not agree with the maximums now shown. Also meets Navy Spec. 44T-39.

Bridgeport Copper Tubing

The marine field is most appreciative of the advantages of copper tubing for pipe lines of all kinds because it combines lightness with strength and maintains tight connections under vibration which would loosen screw thread connections. Navy-type copper and brass tubing is supplied in various gauges to serve all pressure requirements. Braze-type fittings joined with silver solder are generally stronger than the tubing itself. Navy-type tubing is often half the weight of threaded pipe for the same sizes. Because of low internal friction it is sometimes possible to use correspondingly smaller sizes of tubing than pipe. Thus, dead weight can be replaced with valuable cargo. Among marine applications are auxiliary steam lines, condensate and air piping, lubricating oil lines, and smoke detectors.

Note: Bridgeport products are supplied in accordance with existing priority regulations.



BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ESTABLISHED 1865

The efficiency of your plant cannot be judged by how *little* compressed air it uses each shift. What really counts is how *much* it uses, because every cubic foot of compressed air, properly applied, will increase your output and lower your costs. You need enough to do the jobs that can be done *only* by compressed air, and to do all of the other jobs that can be done *better*, *faster*, and *cheaper* by compressed air than by any other form of power.

You can save money, too, by selecting and installing the most economical compressors. For air power at pressures from 80 to 110 pounds per square inch, Ingersoll-Rand builds hundreds of types and sizes ranging from 1 to 15000 cubic feet per minute. These require from ½ to 3000 horsepower, and are driven by electric-motor, steam-, oil- or gas-engines.

No matter how many cubic feet you need, an Ingersoll-Rand Service Engineer can probably help you improve your present plant, and help select the best machines for any additional capacity that you may need.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

1-578

COMPRESSORS AND AIR TOOLS BUILT AND APPLIED BY THE MEN WHO KNOW AIR POWER

ROTO TUBE CLEANERS

for

IMMEDIATE DELIVERY

from Stock

Here is good news for all who need tube cleaners. We are now able to ship normal requirements for tube cleaning equipment directly from stock, despite a record demand for Roto Tube Cleaners by war plants, the armed forces, and Allied merchant navies.

Greatly enlarged and improved production facilities enable us to make immediate deliveries, regardless of priorities.

Write, wire or phone your nearest Roto representative, or contact us directly.

ROTO DIVISION of ELLIOTT COMPANY

145 Sussex Avenue **Newark 1, N. J.**

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

You get all of these advantages in one grease

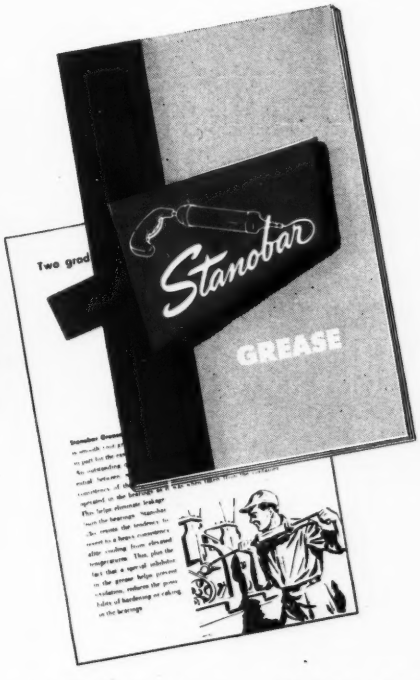
A wide range of temperature application

Plus grease gun or one-shot lubrication

Plus unusually long life

Plus better lubrication — less thinning out

Send for this booklet



One outstanding advantage of Stanobar Grease is that it can be applied by grease gun on a wide range of anti-friction bearing lubrication jobs. That's because Stanobar Grease has a smooth, non-fibrous, texture which is unusual in a grease that is suitable for both high and low temperature service.

There are other reasons—explained in the booklet offered—why Stanobar Grease can help you eliminate grease lubricating problems. Send for a copy or ask a Standard Oil Lubrication Engineer about the application of Stanobar Grease on your particular job. Write Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Illinois, for the Engineer nearest you.

—it tells why Stanobar Grease gives the advantages listed above wherever it can be applied to your anti-friction bearing lubricating job. Ask your Standard Oil Industrial Service Representative for a copy of the book, or write or call the nearest Standard Oil Company (Indiana) office.

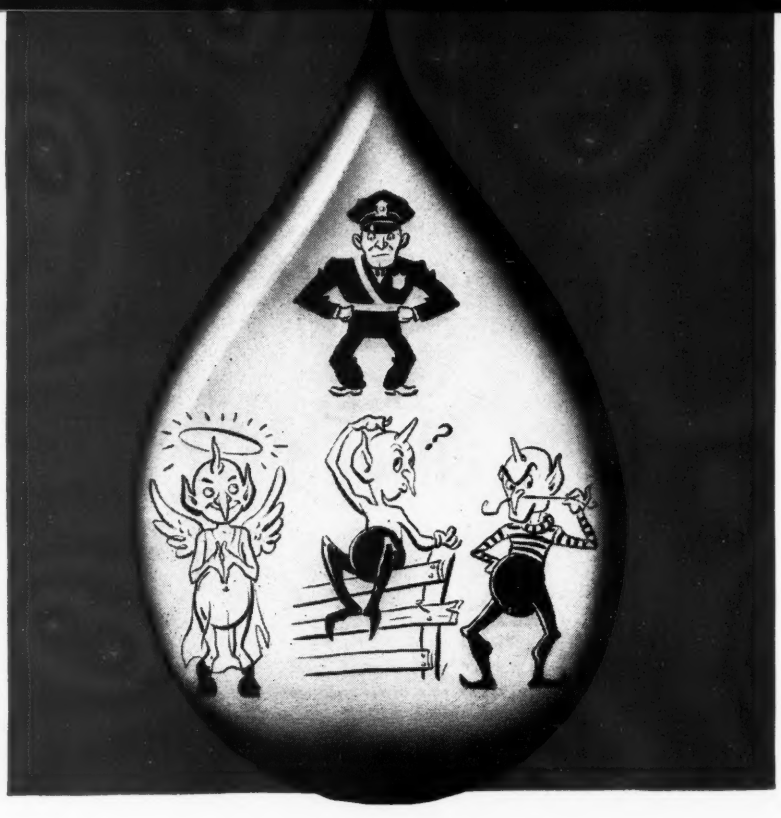
Buy more War Bonds

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

★ LUBRICATION ENGINEERING

If you could take a drop of turbine oil apart...



you'd see why troublesome acidity and deposit formation are eliminated with

NONPAREIL
TURBINE OIL

PETROLEUM CHEMISTS can take a drop of oil apart and put it together again. They explain what they find with complicated signs and symbols. But here's a practical explanation.

A drop of unrefined oil is peopled with innumerable types of hydrocarbons—some good, some bad, and some on the fence. It also contains natural oxidation-inhibitors. These are the policemen that help keep order in this world of hydrocarbons.

All of the hydrocarbons have a thirst for oxygen. The principal difference between them is this: The bad hydrocarbons take all the oxygen they can get. The natural inhibitors can't stop them. The good hydrocarbons, and those on the fence, can take it or leave it alone. They are good as long as the natural oxidation inhibitors are around.

When the bad hydrocarbons are put into a turbine, where there is plenty of both heat and oxygen, they go from bad to worse. Some of them form the asphalt-like sludge you may have found in a turbine. The natural inhibitors can't do much about this because they are overcome in the free-for-all oxygen spree.

It seems obvious then that the first step in making a good turbine oil is to take out all the bad hydrocarbons. But here's the catch. Refining methods that take out the bad hydrocarbons also take out the natural inhibitors. Without them the good hydrocarbons and those on the fence are ready to "raise cain." When the good hydrocarbons get too much oxygen they cause other turbine oil troubles as a result of rapid acidity development.

Therefore, most conventional turbine oils are made by leaving in them part of the bad hydrocarbons (even though they eventually form deposits) in order to keep enough natural oxidation inhibitors to slow down acidity formation.

But this oil is a compromise. Standard Oil chemists wanted a better solution. They wanted to use a highly refined oil and eliminate all asphaltene deposits. It could be done by adding an oxidation inhibitor to take the place of the natural ones. The hitch here was finding that inhibitor.

Standard Oil developed such an inhibitor. It was added to a highly refined white oil, the process was patented, and the product was called Nonpareil Turbine Oil. That's why Nonpareil is the only turbine oil that is completely free from asphaltene-forming hydrocarbons, with a *guarantee in writing* that it will not increase in acidity above the low neutralization number of 0.15 mg. KOH/gm. for the life of your turbine.

A Standard Oil Lubrication Engineer can tell you what this freedom from deposits and acidity formation means in lower maintenance costs and greater safety of operation. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

Buy more War Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

How BAILEY CONTROLS Improve Power Service

IN YOUR PLANT

There may be opportunities for the improvement of power service as well as for increasing safety, saving fuel and reducing maintenance by the proper application of Bailey Controls. Get the recommendation of your local Bailey Engineer or write for Bulletin 15-C describing Bailey Controls for Steam Plants. Bailey Meter Company, 1040 Ivanhoe Road, Cleveland 10, Ohio. In Canada—Bailey Meter Company Limited, Montreal.

A-94

CONTINUITY

Fewer outages of boilers and prime movers improve continuity of power service.

CAPACITY

In addition to increasing steam generating capacity Bailey Controls also increase output and efficiency of prime movers by supplying steam at design conditions.

HEAVY LOAD SWINGS

Simultaneous regulation at all points of control accurately and safely takes the boiler through heavy load swings.

PROCESS STEAM

Steam at correct pressures and temperatures for process operation is furnished by combustion and steam temperature controls. Pressure reducing and desuperheating control systems insure adequate low pressure steam. Combustion control usually does away with the need for a steam accumulator.

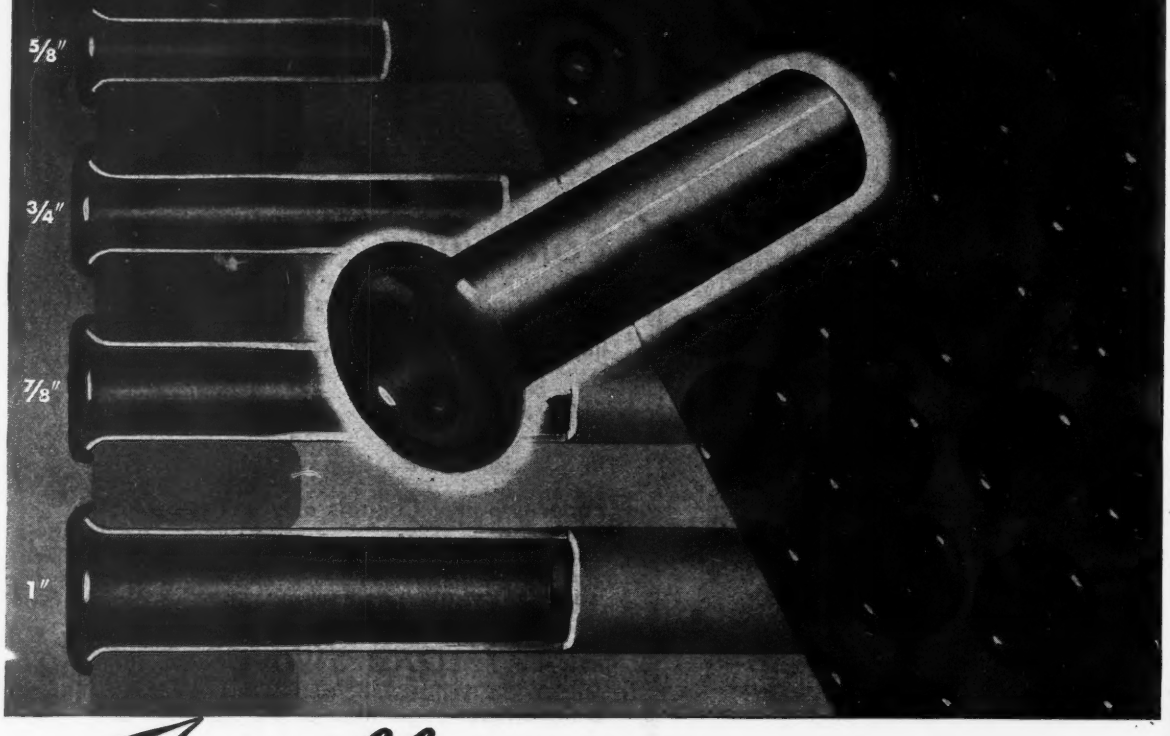
BAILEY METER COMPANY

1040 IVANHOE ROAD • • • CLEVELAND 10, OHIO

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Save CRITICAL TUBE METAL



Install JOHN CRANE
CONDENSER TUBE PROTECTORS

The inlet end of the condenser tube is most often the first section to fail. This is the area most vulnerable to air impingement and sand abrasion. Service Tests in Marine and Stationary Condensers prove that John Crane Condenser Tube Protectors *armor the entrance section; greatly lengthen tube life.* Note these other important advantages:

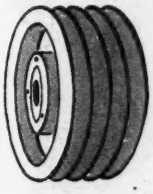
- **Molded of a hard, wear-resistant plastic material**
- **Resist contaminated salt or fresh water**
- **Unaffected by temperatures to 275° F.**
- **Provide a belled mouth for inlet tube ends; reduce turbulence**
- **Easily installed on both old and new tubes**
- **Last for life of tubes**

John Crane Condenser Tube Protectors are inexpensive to install; and require no special tools. Available for 5/8" and 3/4" 16-BWG, or 5/8", 3/4", 7/8" and 1" 18-BWG tubes. For full information send for *illustrated* bulletin, or consult our branch office *nearest you.*

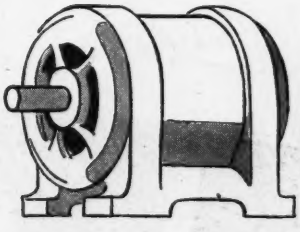
CRANE PACKING COMPANY
1812 CUYLER AVENUE • CHICAGO 13, ILLINOIS

Just like this

this goes

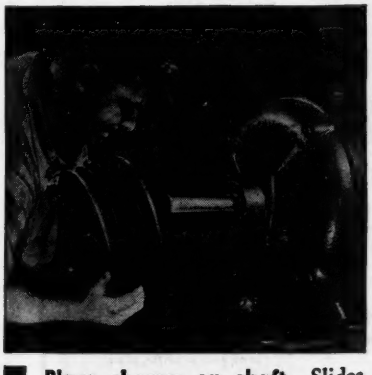


on or off this



Yes, it's a snap to change sheaves now, when you provide Allis-Chalmers' new "Magic-Grip" — *fastest mounting and demounting sheave on the market.* Saves time and money.

SEE WHY THE NEW "MAGIC-GRIP" MOUNTS FAST, PERFORMS SMOOTHLY



1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.

2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge . . . giving you true alignment with resulting smooth performance. A minimum of time is required.

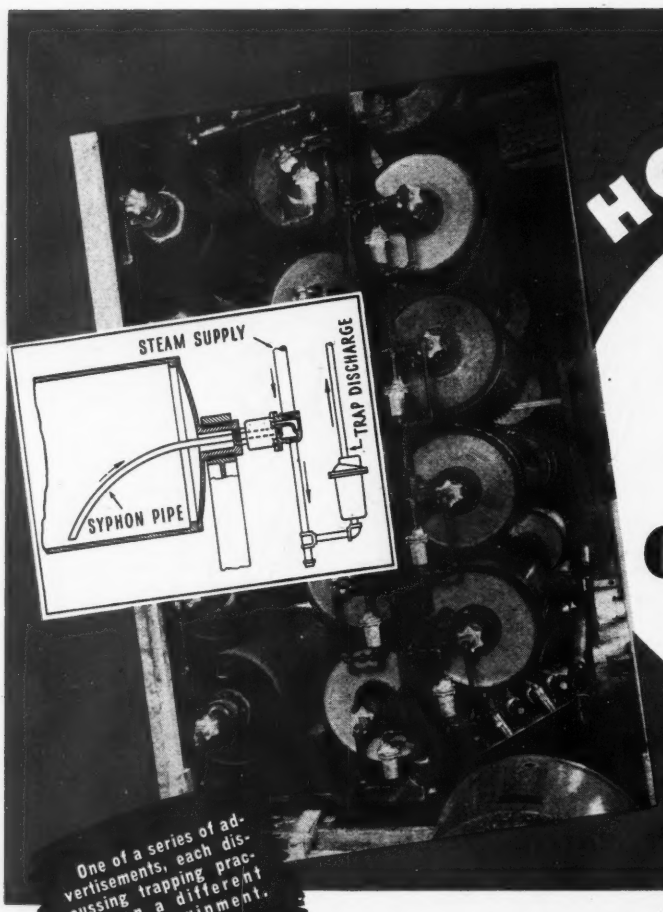
3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1857

Allis-Chalmers Texrope

"MAGIC-GRIP"

SHEAVES



HOW TO TRAP SYPHON DRAINED CYLINDERS

to secure Maximum temperatures

One of a series of advertisements, each discussing trapping practice on a different class of equipment.

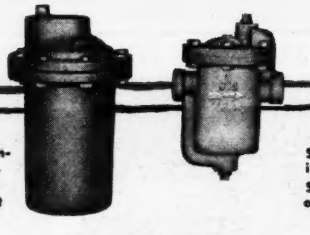
Paper Company Raises Temperatures of Corrugating Rolls 50%

Drainage of condensate from dry cans, slashers, sizers, corrugating rolls, double drum dryers and similar equipment requires a *practical experience* in installation practice plus traps capable of handling air as well as condensate. Armstrong offers both.

As a result, engineers have been surprised to find that despite previous trapping, Armstrong trap installations can effect results like these:

A Pittsburgh paper company raised corrugating roll temperatures 50% . . . a textile mill installed 200 Armstrong traps on dry cans after tests showed higher temperatures . . . Hyde Park Laundry, Chicago, increased ironer production 28%.

An Armstrong representative will be glad to call at your request. ARMSTRONG MACHINE WORKS, 810 Maple St., Three Rivers, Mich.



Trapping Tips*

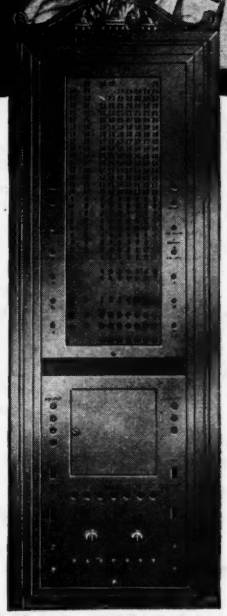
- Be sure syphon pipe is curved downward, with the end of the pipe close to the shell.
- Use traps with ample air venting capacity.
- Be sure there is no dirt in syphon pipe and end is not burred.
- Use a trap on each cylinder.
- Be sure there are no leaks in syphon pipe.

*Complete, useful data contained in 36 page ARMSTRONG STEAM TRAP BOOK. Write for a copy — free on request.

ARMSTRONG STEAM TRAPS

Over a Million in Use...For Power...Process...Heating

OTIS *Dispatching* FOR IMPROVED ELEVATOR SERVICE



Dispatching Panel: Indicates position and direction of travel of the car and the location of waiting passengers.

Otis Elevator dispatching methods and equipment can help correct congested elevator traffic conditions.

This scientific system of elevator operation and dispatching provides the highest quality and maximum quantity of service for a given number of elevators.

Otis dispatching is your assurance that every car is doing an equal share —that the flow of traffic is evenly distributed over the entire plant.

So, when it comes to new elevator installations or getting more work from your present equipment, investigate the possibilities offered by Otis dispatching equipment.

Your Otis representative is ready now to help you and your Architect plan the correct type of dispatching system best suited to your needs. For the finest in vertical transportation tomorrow, call your Otis representative TODAY.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

Seal High Pressure Lines This Modern Way . . . and they STAY SEALED!

NO LEAKAGE . . . for 33 years, Flexitallic spiral-wound Gaskets have proved their ability to handle joint sealing problems that other gasket types have left only partially solved. There is no high-pressure gasket problem that Flexitallic cannot solve better and cheaper in the long run!

NO BOLT STRESS PROBLEMS . . . the unique Flexitallic construction makes the joint semiflexible, thus compensating for shocks and sudden line stresses. Centering and gasket yield are balanced with joint bolting and service requirements are minimized.

NO VIBRATION WORRIES . . . flexitallic Gaskets automatically adjust themselves to meet changing or adverse conditions such as vibration, expansion, contraction, etc. On the most exacting wartime jobs, Flexitallic has successfully met one emergency after another — after other gasket types failed.

CHEMICAL PROBLEMS . . . gaskets of special non-contaminating materials represent only one of the many Flexitallic types regularly produced. Whatever your gasket requirement, Flexitallic can match it!

NO MAINTENANCE . . . besides reducing gasket maintenance to a minimum on high-pressure or high temperature applications, Flexitallic holds widespread possibilities for low-pressure use. A slightly higher first cost can mean a lifetime of trouble-free service!

Made in a complete line for extreme temperature and/or pressure ranges for pipe flanges and pressure vessels including boiler manholes, handholes, waterwalls, superheaters, economizers, Diesel and gas engines, pumps, etc. Write for catalog.

"Flexitallic"

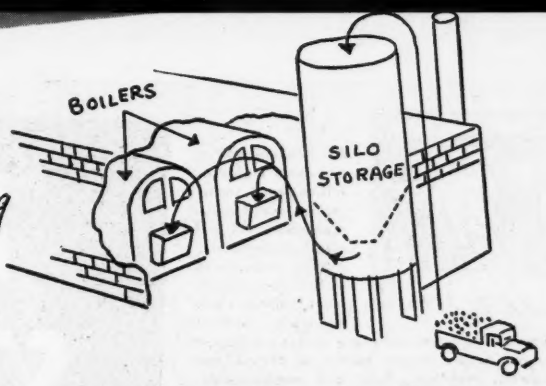
REG. U. S. PAT. OFFICE

FLEXITALLIC GASKET COMPANY

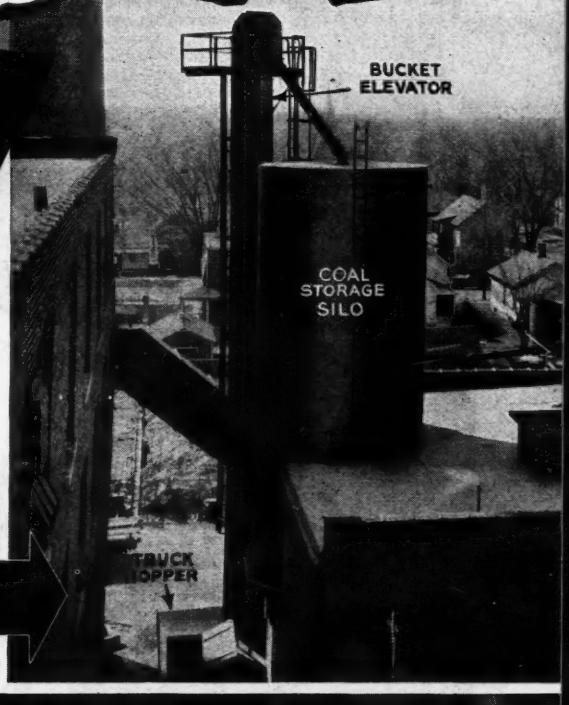
8th & BAILEY STREETS • CAMDEN, NEW JERSEY

SAFE, SURE SEALING FOR HIGH-PRESSURE APPLICATIONS

The Problem —
To eliminate dust in yard and plant interior while delivering coal automatically and economically to two boilers.



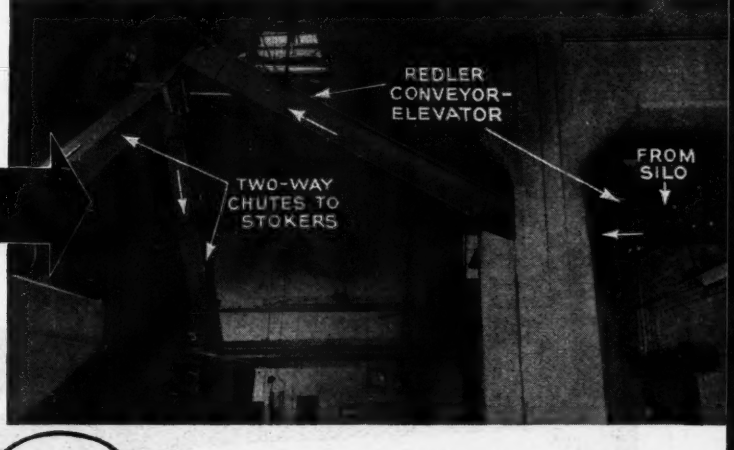
THE S-A ANSWER



● Elimination of coal dust in a residential neighborhood is desirable, but certainly not a simple problem. That's why this S-A engineered and installed REDLER System should interest many power plants. It not only cleaned up the exterior dust problem, doing away with a bulky, dirty yard storage pile . . . but it also eliminated coal dust inside the plant, while providing automatic and economical feeding of coal to two stoker hoppers.

CLEAN OUTSIDE

A Truck Hopper receives the coal, which is withdrawn and elevated to the top of the silo by a screw feeder and a Bucket Elevator. Coal is fed to the compact, overhead REDLER Conveyor from the silo by gravity. No chance for dust to get out anywhere in the process.



CLEAN INSIDE

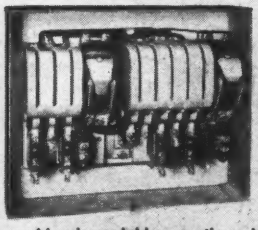
Compact, out of the way, the REDLER Conveyor-Elevator automatically feeds coal to the two stoker hoppers. There's no chance for coal dust to reach the inside of the plant either, thanks to the completely sealed casings of the REDLER.

STEPHEN S-A DAMSON MFG. CO.

515 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

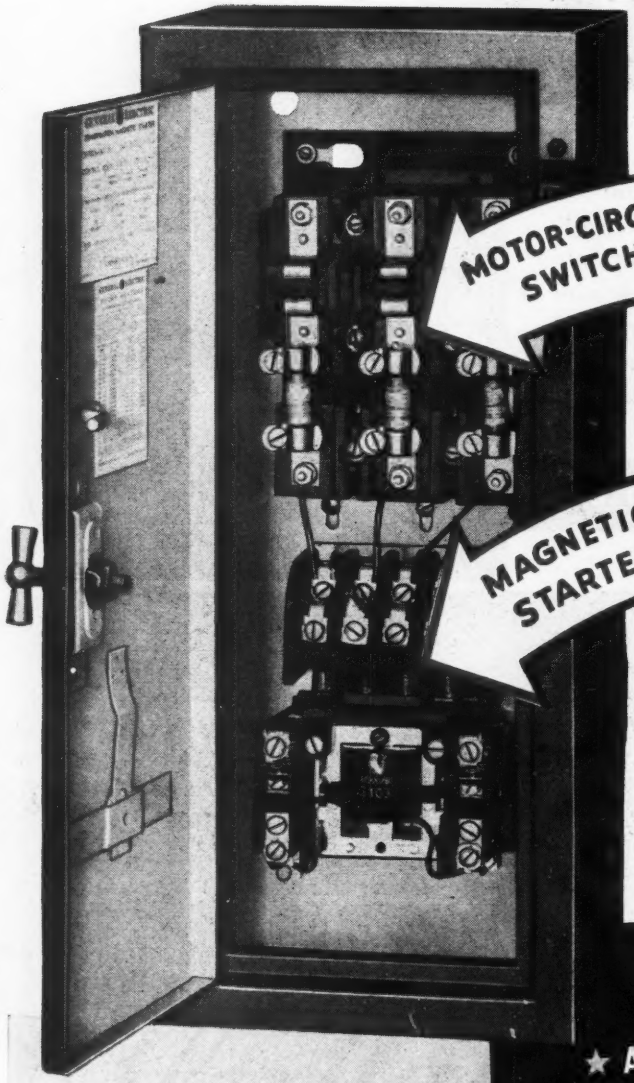
BULK MATERIAL HANDLING EQUIPMENT



For frequent starting or remote control. A full-voltage starter for two-speed squirrel-cage motors, and also available for starting three-speed or four-speed squirrel-cage motors. This particular switch provides dependable operation where motors are started frequently, and where remote control is desired—on pumps, blowers, ventilating fans, and machine-tools.

MOTOR STARTERS

EVERY TYPE, EVERY SIZE,



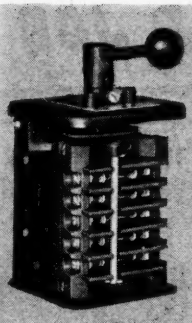
WHY BUY TWO DEVICES WHEN ONE WILL DO THE JOB?

This G-E COMBINATION STARTER gives you in a *single* package both a motor-circuit switch and a magnetic starter.

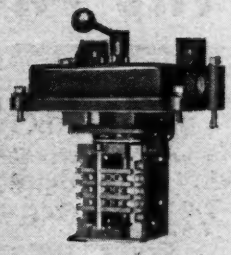
INDUSTRIAL CONTROL

★ DEPENDABLE
★ ATTRACTIVE IN APPEARANCE
★ DESIGNED TO BLEND WITH MODERN MACHINES

For full-voltage starting of squirrel-cage a-c motors



Small size—general purpose. Our small-size switch is cam-operated and spring-return to the off position. This particular device is recommended for single-speed reversing service or for two-speed non-reversing service.



Small size—dust-tight and watertight. The small size, too, comes in a variety of enclosures to meet different operating conditions. An example is this three-pole, reversing, rotating-cam switch in a watertight and dust-tight cast-iron case. It provides one point forward and one point reverse.

FOR EVERY MACHINE APPLICATION

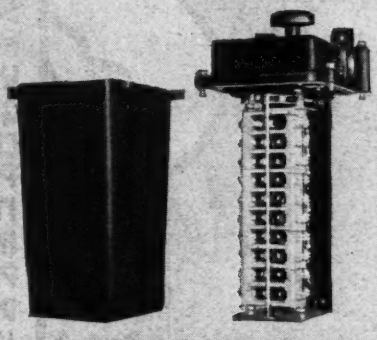
When you need motor starters, be sure to investigate G.E.'s complete line—perhaps some may give you important savings in time, space, or materials.

Take combination starters, for example—because you buy one packaged unit, less time is required for ordering and for installation. You can save space, too, by mounting them in small, unused spaces either near to or remote from the operator. And critical materials are conserved because these starters have less copper wire, steel conduit, and fittings than separately mounted devices.

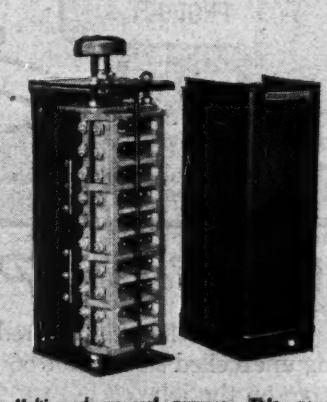
Also shown here are other G-E starters—leaders in their field. They range from a general-purpose type of rotating cam switch to a full-voltage, multispeed magnetic starter. Frequent starting, remote control, different starting speeds, and many other special requirements can be obtained by selecting one of these starters.

And all G-E starters come in a variety of enclosures designed to meet different operating conditions.

We'd like to send you any additional information you may want. And remember, our engineers will be glad to assist you in selecting exactly the right starter for your needs. Get in touch with your local G-E office today. Or if you prefer, write directly to General Electric Company, Schenectady 5, N. Y.



Multispeed—dust-tight and watertight. Rotating-cam switches come in enclosures to meet your needs. Here is a reversing, multispeed, rotating-cam switch in a watertight and dust-tight cast-iron case. This switch provides four speeds forward and one speed reverse.



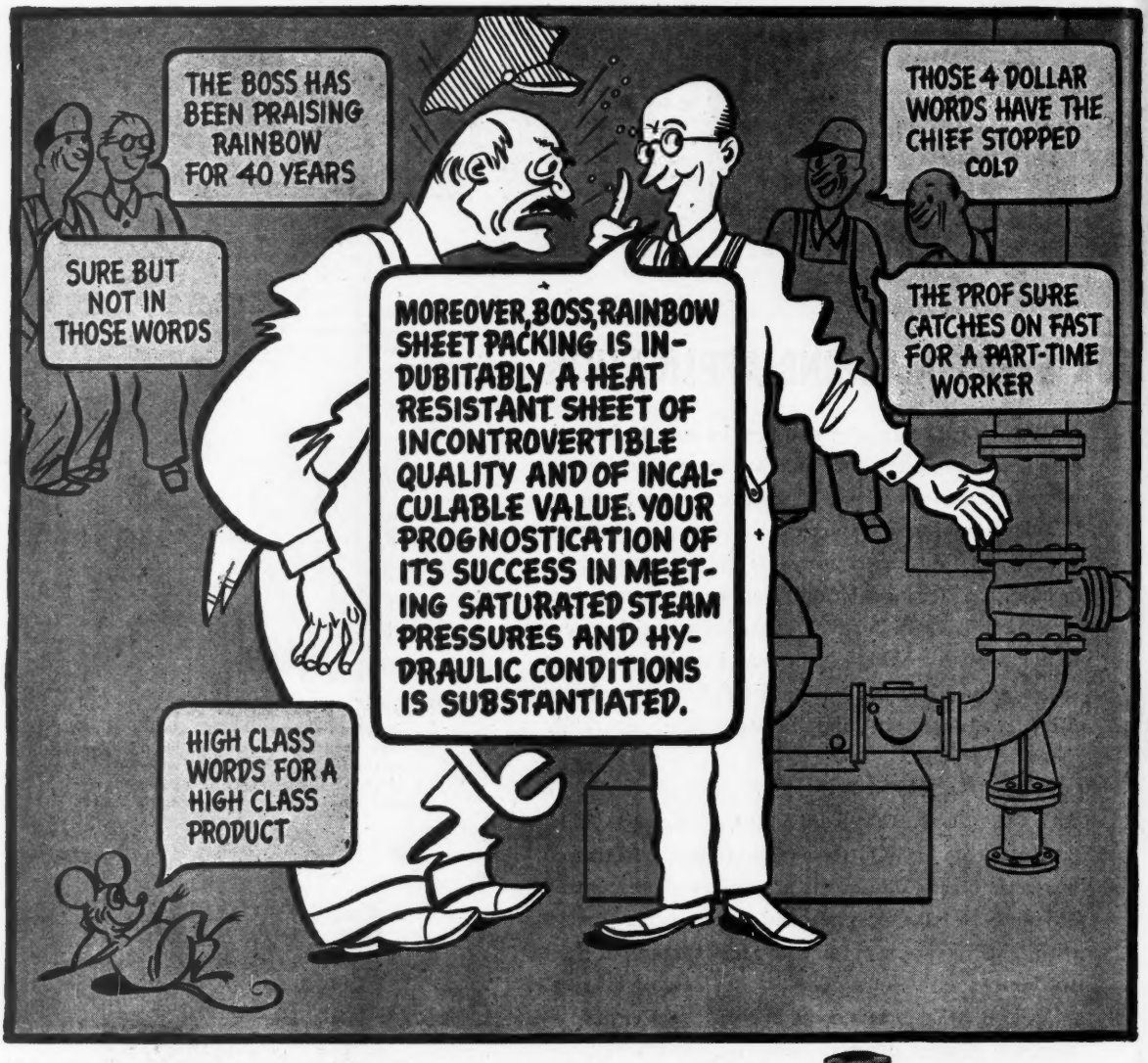
Multispeed—general purpose. This general-purpose type of rotating-cam switch is available for single-, two-, three-, or four-speed motors requiring forward and/or reversing service. Particular care has been taken to assure you of obtaining the long-lived service that you want in a switch.

GENERAL ELECTRIC

676-127-8910

Buy all the BONDS you can—and keep all you buy

THE PROFESSOR TAKES A WAR JOB


THE BOSS HAS BEEN PRAISING RAINBOW FOR 40 YEARS
SURE BUT NOT IN THOSE WORDS
MOREOVER, BOSS, RAINBOW SHEET PACKING IS INDUBITABLY A HEAT RESISTANT SHEET OF INCONTROVERTIBLE QUALITY AND OF INCALCULABLE VALUE. YOUR PROGNOSTICATION OF ITS SUCCESS IN MEETING SATURATED STEAM PRESSURES AND HYDRAULIC CONDITIONS IS SUBSTANTIATED.
THOSE 4 DOLLAR WORDS HAVE THE CHIEF STOPPED COLD
THE PROF SURE CATCHES ON FAST FOR A PART-TIME WORKER
HIGH CLASS WORDS FOR A HIGH CLASS PRODUCT

RAINBOW—*Tops In Packing Since 1889*

Yes, Rainbow, the original red sheet packing, has been giving unexcelled service for 56 years. It will *not squeeze or blow out* on the job.

Packing flanges and other parallel surfaces against hot or cold water, air, saturated steam pressures up to 150 pounds, and all hydraulic conditions—that's Rainbow's specialty.

Don't invite unnecessary equipment breakdowns—order Rainbow and be sure of packing dependability.

Listen to "Science Looks Forward"—new series of talks by the great scientists of America—on the Philharmonic-Symphony Program. CBS network, Sunday afternoon, 3:00 to 4:30 E.W.T.

UNITED STATES RUBBER COMPANY

Serving Through Science

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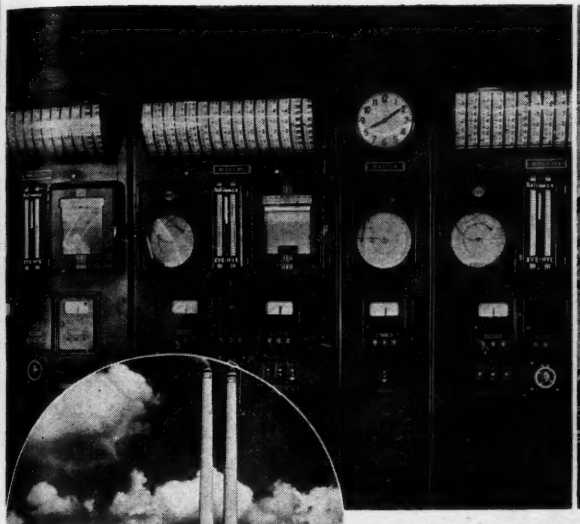
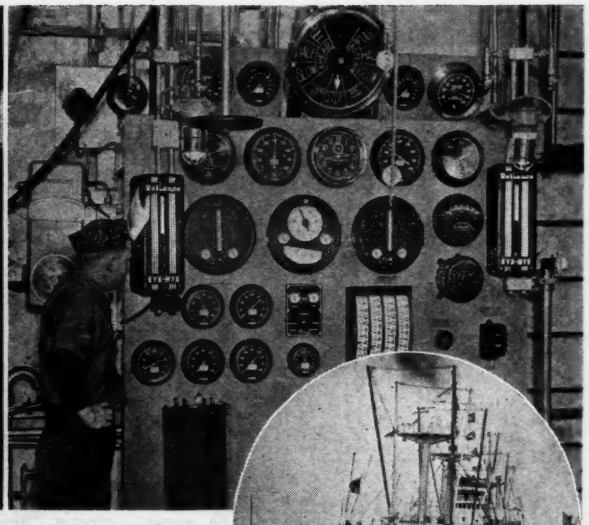
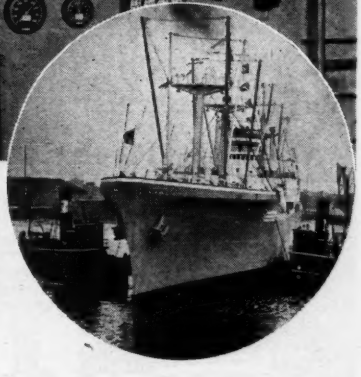






Conveniently mounted on panel board, wall or ship bulkhead, thousands of EYE-HYE*s have been placed in a variety of important control jobs in stationary and marine power plants.*

Remote Reading Water Level Indicator • Completely Hydrostatic

Use EYE-HYE *Anywhere*★

- ★ Stationary Power Boilers
- ★ Marine Power Boilers
- ★ Waste Heat Boilers
- ★ Heating Boilers
- ★ Feed Water Heater Tanks
- ★ Water Treatment Tanks
- ★ Mercury Vapor Boilers
- ★ Storage Tanks
- ★ Surge Tanks

FOR dependable protection against water level accidents and inefficient operation, Reliance EYE-HYE gives you trouble-free indication in familiar water gage form. Its adaptability, and flexibility of placement, have made it popular with engineers responsible for safe water level supervision. The quickly-read illuminated column of green liquid can be placed a considerable distance from and above or below drum or other vessel. EYE-HYE accurately measures liquids on low pressures, even under vacuum, and as high as 2000 lbs. Completely hydrostatic operation with special patented features guarantees consistent, reliable operation. Approved by leading power authorities and consulting engineers — thousands in daily service, protecting vital steam producing capacity.

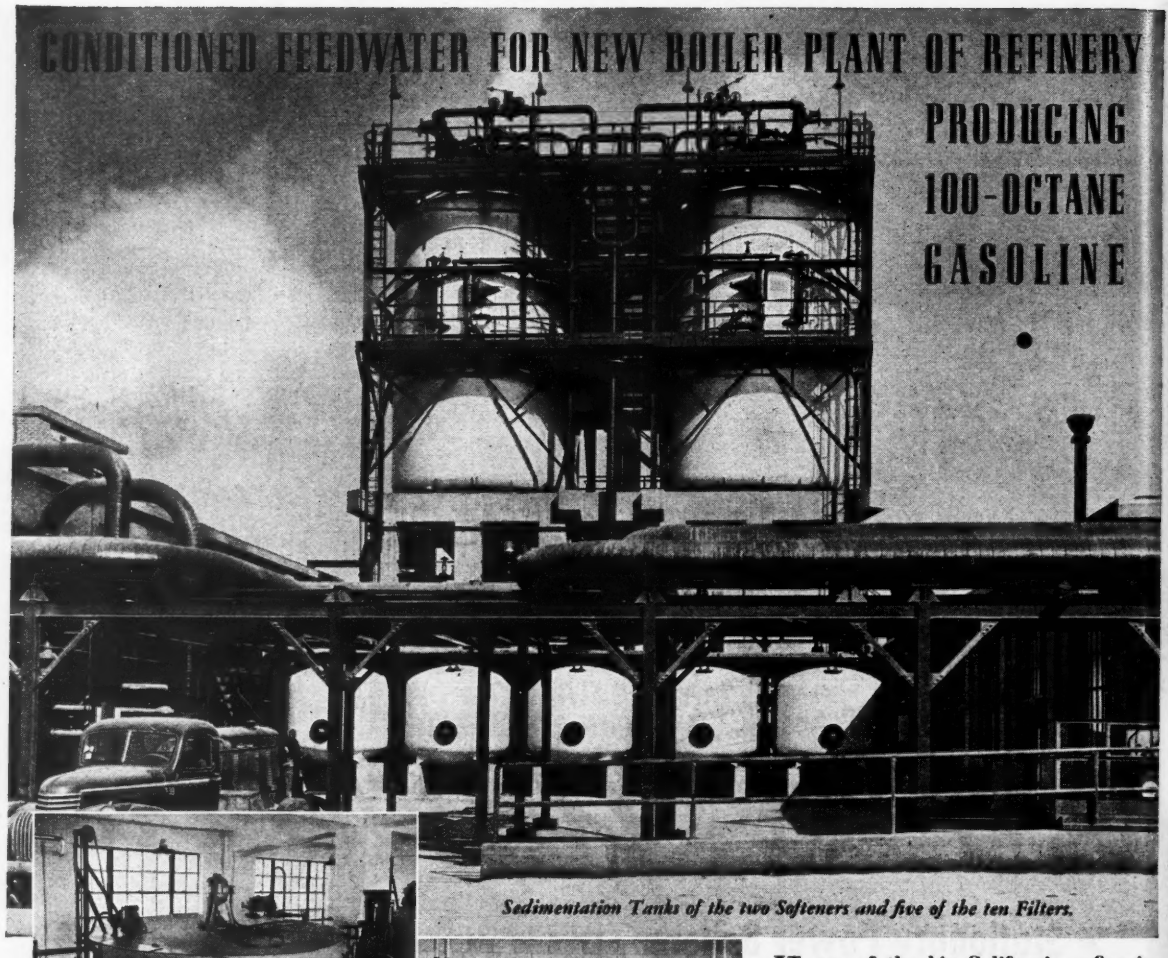
Write for Bulletin 383-C.

BOILER SAFETY DEVICES since 1884

Reliance

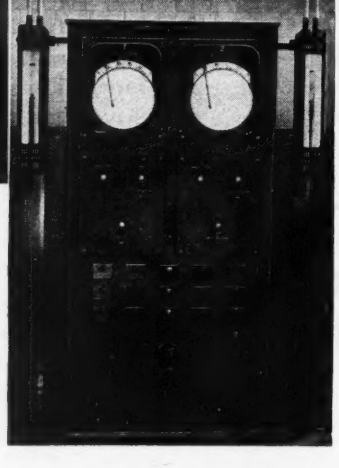
THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

CONDITIONED FEEDWATER FOR NEW BOILER PLANT OF REFINERY PRODUCING 100-OCTANE GASOLINE



Sedimentation Tanks of the two Softeners and five of the ten Filters.

Above—Chemical Mixing Tank.



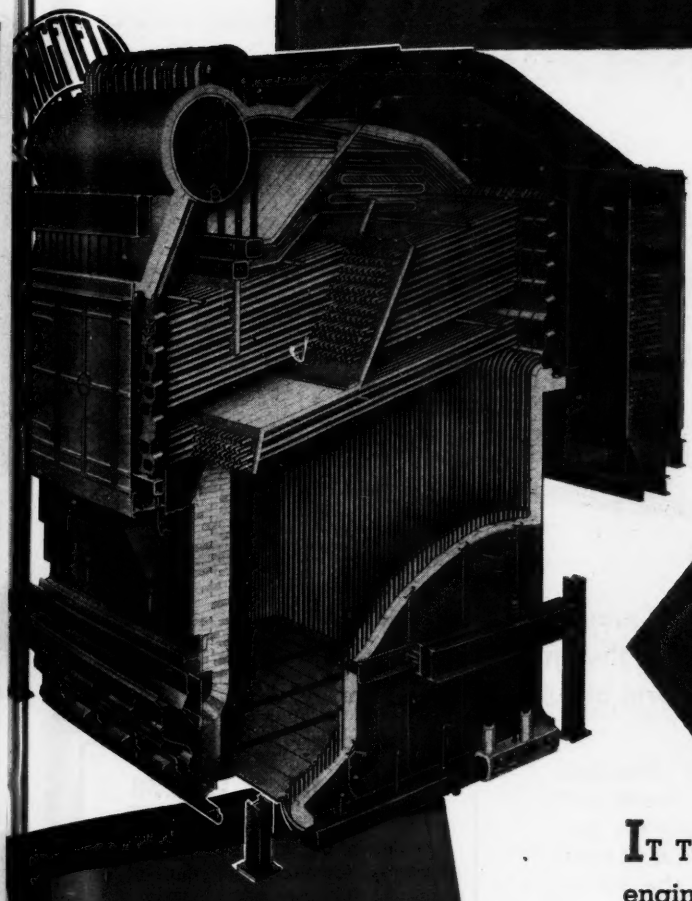
Right — Cochrane Flow Meter Panel Board for Automatic Control of Acid Feed.

AT one of the big California refineries now devoted to the production of 100-octane gasoline exclusively, the installation illustrated here, consisting of two 50,000 GPH, Cochrane Deaerating Hot Process Softeners, with ten 9′ dia. Filters, Mixing Tank, etc., supplies conditioned feedwater to the new high-pressure boilers. Many unique Cochrane features distinguish this installation, among which are a stirring mechanism which reduces turbidity to less than 5 ppm, automatic sludge blow-off, backwashing of filters with filtered water and panel board control of chemical feeds. • Write for complete details of this job or for a copy of Publication 3000, "Hot Process Softeners."

COCHRANE CORPORATION • 3123 N. 17TH STREET • PHILADELPHIA 32, PENNA.

COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES



CAST STEEL HEADERS — permit tighter rolled tube joints.

SECTIONAL ONE PIECE BAFFLES —make a rugged, permanently tight baffle wall.

STAGGERED GROUP TUBE ARRANGEMENT — gives maximum heat absorption, producing higher efficiency.

SECTIONAL HEADER DESIGN — saves 30 to 60 days erection. Tubes rolled in headers at factory.

PERMANENTLY TIGHT BAFFLES —records show as much as 20 years without maintenance.

SINGLE CROSS DRUM—designed for fast, dry steaming.

It took thirty years...

...to design this boiler!

IT TOOK OVER 30 YEARS and plenty of engineering courage to develop the modern Springfield boiler. In order to bring about higher efficiencies, faster steaming, greater responsiveness to load change, longer life of parts with less frequent and easier maintenance, Springfield engineers had to depart from previous concepts of design.

The fact that the first modern high ratings were accomplished with Springfield boilers is evidence of the success of this course.

For information on units to meet your requirements, write: SPRINGFIELD BOILER CO., 1951 E. Capitol Ave., Springfield, Ill.

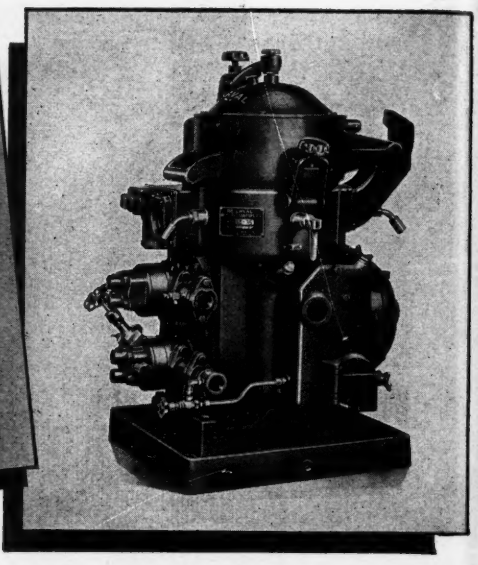
SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE ANY FUEL ANY PRESSURE

TURBINES and DIESELS ARE ONLY HALF PROTECTED UNLESS BOTH DIRT and WATER are REMOVED from the OIL



DE LAVAL OIL PURIFIERS **afford *full* protection against the principal causes of lubrication failure. They remove the impurities that contaminate oil in service and enable the oil to perform at full efficiency indefinitely. Why?**

BECAUSE – De Laval Oil Purifiers instantaneously remove by centrifugal force ***both*** of the chief enemies of good lubricating oil performance — ***water*** and ***dirt***. With a De Laval, there is no such thing as doing half the job — the protection to the prime mover is the maximum possible.

In the case of turbo-generating systems, the trouble-maker is usually sludge, and sludge forms fastest when water is present in the oil. De Lavals of proper capacity on continuous by-pass, purifying the oil in circulation three to four times daily, minimize sludge formation.

By removing water more completely from Diesel oil, the De Laval Oil Purifier helps prevent the formation of emulsions with the oil — a fact of especial importance when new heavy types of lubricating oil are used.

Protection from dirt is equally positive. Centrifugal force applied in the De Laval bowl removes any solid impurities more completely and quicker . . . keeps the oil clean and in "like new" condition.

ADVANTAGES OF DE LAVAL LUBRICATING OIL PURIFIERS

Maintain oil in condition most nearly identical with that of new oil

•

Provide maximum protection to power units

•

Constant high purifying efficiency—without renewal of functional parts

•

Remove both enemies of good lubricating oil performance: water and dirt

•

Economical to operate

•

Give long, trouble-free service

•

Lower maintenance costs

•

Self-draining purifier bowl makes for easy cleaning

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

DE LAVAL
LUBRICATING OIL PURIFIERS

THE FOG THAT BLOTS OUT FIRE

OFFICIAL U. S. NAVY PHOTOGRAPH

...starts here

WaterFOG . . . the newest of fire-fighting methods . . . is especially valuable in choking off concentrated fires aboard ship or in plants. Even oil fires and fires around electrical apparatus now can be extinguished with water.

Sending out a stream of atomized water particles, WaterFOG blankets the blaze – chills the heat – cuts off the fire's "breath"– *and smothers the flames.*

In WaterFOG nozzles, tiny openings are so paired that streams of water impinge and shatter into mist.

The nozzle holes are only 1/16" in diameter. Any foreign matter reaching them could easily cause clogging. For protection, two strainers are used; one at the hydrant or water pump; the other in the nozzle itself.

After investigating the metals and alloys which could be used to make these strainers, the Rockwood Sprinkler Company, Worcester, Mass., selected Monel. *For:*

Monel is strong and hard! Tests showed that light-gauge Monel strainers could resist the erosion and abrasion of water and solid particles blasting against them at pressures up to 600 psi.

Monel resists corrosion! Any convenient source of water can be used for WaterFOG. Monel strainers withstand corrosion by all kinds of water – *fresh, salt* or *polluted.*

Monel is readily workable! Strainer openings must be even smaller than the 1/16" openings in the nozzle. In turn, the Monel sheet from which these strainers are made is thinner than the strainer openings. And, as the photographs show, fabricating the strainers requires a ductile material easily shaped. Monel strainers can be joined by welding or soldering.

Rockwood's choice of Monel has paid off well. Every Monel strainer in WaterFOG installations in ships at sea or in industrial power plants ashore is still giving perfect service.

FIRE PLUG STRAINER *with Monel strainer. Made by Rockwood Sprinkler Company. Quick-flushing type, approved by the Bureau of Ships, U. S. Coast Guard and Maritime Commission.*

Upper figure shows nozzle with Monel screen. Used in WaterFOG equipment for fixed installations. Fine-gauge Monel strainers withstand 600 psi . . . high temperatures . . . severe corrosive attack.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK 5, N. Y.

MONEL®

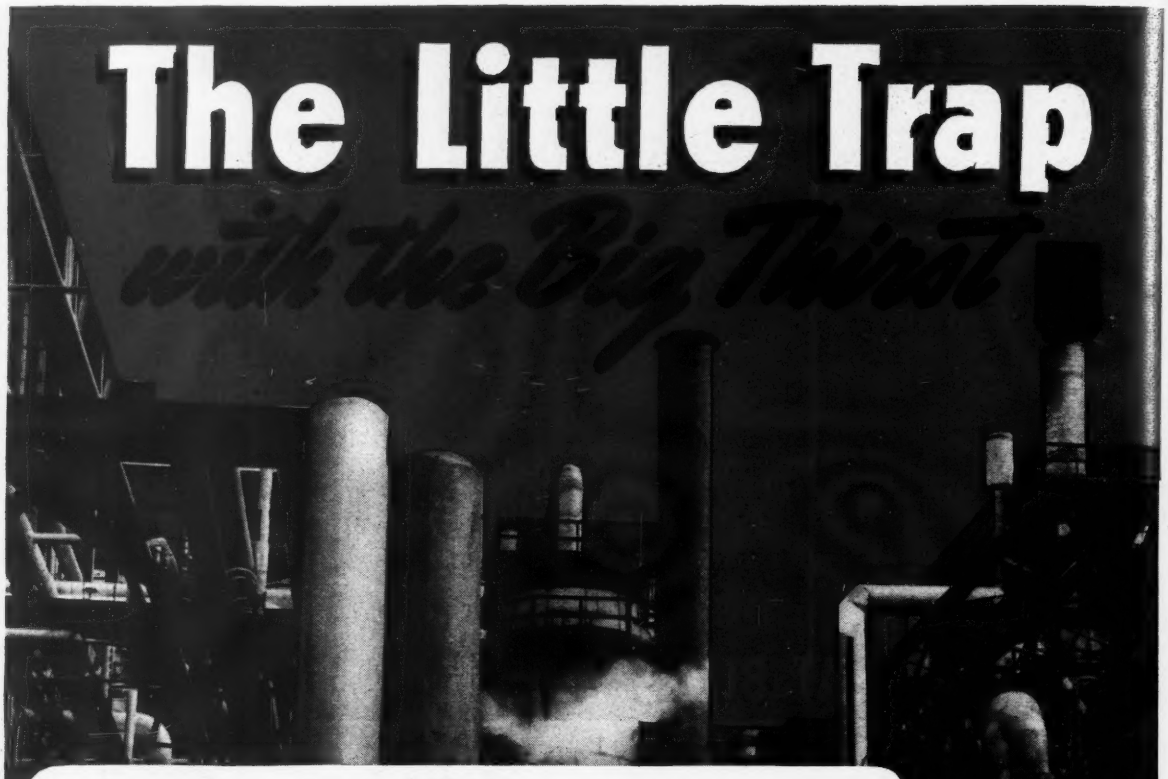
NICKEL INCO ALLOYS

•Reg. U. S. Pat. Off.

MONEL® • "K" MONEL® • "S" MONEL® • "R" MONEL® • "KR" MONEL® • INCONEL® • "Z" NICKEL • NICKEL • *Sheet . . Strip . . Rods . Tubing . . Wire . . Castings . . Welding Rods (Gas & Electric)*

The Little Trap

with the Big Thirst



Yarway Impulse Steam Traps—those little traps with the big thirst—are doing a giant's job for hundreds of plants in many industries throughout the country.

For instance, Yarways are ideally suited to refinery work because they literally *drink* the condensate—discharging continuously on heavy loads, intermittently on light loads. Hence they provide maximum heat in the shortest possible time.

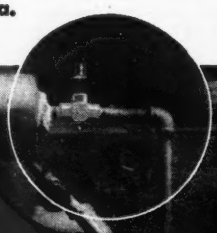
Yarways are all-weather traps, equally efficient outdoors or in—require no protection against freeze-up.

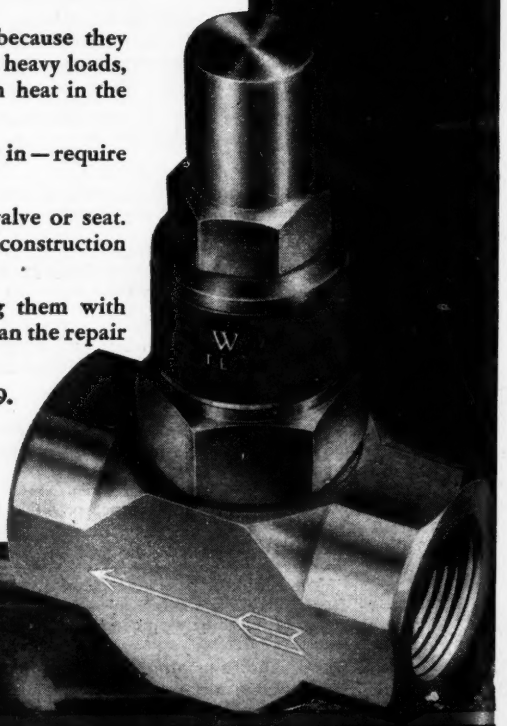
Yarways are suitable for all pressures without change of valve or seat. Compact design makes them easy to install, and simplicity of construction (only one moving part) minimizes maintenance.

Next time old-type traps need repair, consider replacing them with Yarway Impulse Traps. New Yarways frequently cost less than the repair job. *Already more than 400,000 have been bought!*

See your nearest Supply House, or write for Bulletin T-1739.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.





YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

How Business Can Regain Leadership

By HOWARD COONLEY

A RECENT writer on business management has said: "There is nothing vague about the imminent probability that business is going to be operated either for society or by society." I concur with the business analyst who recently made that statement. Business has to make up its mind which alternative it wants and how to go about its basic reconversion job—turning the operation of private business to social as well as individual profit. Social gain must be written into the charter of corporate private enterprise.

When the pressure of the war is over the questions uppermost in the minds of our people will be: How can we employ the tremendous growth of productive capacity induced by the war program to satisfy the wants of our people? What shall we make? How shall we get it distributed? How shall we keep up employment in our factories? How shall we continue the forward progress with more products going to more Americans? Business will have to find the right answers to each of those preplexing but vital queries.

In preparing to meet these challenges of the years ahead, neither business nor anyone else should raise false issues, or look backward rather than forward. Business must realistically recognize that it is required to assume ever increasing social responsibility, and, whether we of business like it or not, to live with an increasing amount of supervision and regulation of our economic activities. Will business not only in individual units but also through its associations representing large sectors of business, undertake self-regulation and self-control in cooperation with government? Or, on the other hand, will business suffer the increasing imposition of arbitrary controls because some elements in business and industry too fondly cherish the memory of privileges enjoyed in an age gone by?

During the past few years business men have been resentful of increasing regulation on the part of government. From my experience as a business man, I would say that some just causes for resentment have arisen. Yet there has been, and still is, too little constructive action on the part of business in taking hold of untoward situations and working out those solutions before the problems get out of hand. If we were to list all the regulatory agencies that are now operating under the authority of the national and state governments, we should find many cases in which, prior to the establishment of the regulatory agencies, business men had not made a determined co-operative effort, in an organized way, on their own initiative, to remove the occasion for public regulation.

Our free enterprise system cannot survive by a policy of mere negation. We have not realized the possibilities of our extensive facilities for voluntary cooperation. The people turn to government and vest it with increasing authority over private activities about in the same proportion as those engaged in the activities fail in self-discipline and self-regulation. And that way pursued too far leads to the totalitarian state.

Equal Responsibility to Public and Stockholders

To the consumer and to the public generally business has a well defined responsibility. The consumer, in the last analysis, determines profits, wages, even the continuance of any business. Management must adjust costs and efficiency of production and distribution to market requirements, and labor must cooperate to the same end. When either business or labor in any enterprise fails to recognize not only the proper interest of all parties actively engaged in it, but also the needs of the consumer, and the broader concern of the public at large, and the authority of government, it must bear eventually the consequences of such neglect. Nor is merely passive recognition enough; there must be active, constructive exercise of responsibility, both in individual enterprises and in associated effort throughout each field of industry.

In the production, distribution and exchange of goods and services we all wish to continue to depend largely on the private enterprises of our people. Few among us seem to want a comprehensive state socialism, in which a central government authority determines what shall be produced and by whom and how, and dictates likewise the processes and terms of distribution and exchange—a system under which we shall all be government employees. There will no doubt continue to be, however, an extensive area of government services, for the public will undertake, through some government agency, services which it decides may thus be more satisfactorily performed than by private enterprise. Certainly also such public regulation of private enterprise will be provided as is deemed necessary for the common welfare, where free competition and voluntary cooperation fail to meet the need. Yet though this is true, it is also proper to assume Americans generally do not favor radical reduction of the

(Continued on page 126)

For nearly thirty years, first as president and then as chairman of the board of Walworth Co. the author of this article, Howard Coonley, has had a major share of responsibility for that company's policies, practices and relations. He has also had other relations with many fellow business men, as a director of a number of corporations and, in the past few years, as president and chairman of the board of the National Association of Manufacturers. Since the war began, Mr. Coonley has been head of the Conservation Bureau of WPB, until the President of the United States and Donald Nelson asked him to accompany the latter on his mission in China. On Mr. Nelson's return to this country, Mr. Coonley remained in Chungking in charge of our mission. He sent this article from Chungking, through BNS, for the exclusive use of *Power Plant Engineering*. Because of the far-reaching effects of the engineer's work on our entire economic system, he must think hard and straight about the factors Mr. Coonley discusses. The engineer's function in the economic system will influence, and will be influenced by, the actions we take in the future about those factors.

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Fig. 1. Section of assembly building area

Three-Phase, 440-254 V Lighting for Aircraft Plants

BY H. F. MITER
Vice President

AND F. N. STRAUS
Project Mechanical Engineer

The Austin Company

THE HUGE EXPANSION and enormous size of industrial buildings demand a new technique in the design and layout of lighting and power distribution. Speed of construction and installation of facilities combined with the conservation of critical materials has been recognized as outstanding in the vitally important prosecution of our war effort.

In the past, we were concerned with the average conventional type of industrial building having a clear height of 12 to 20-ft below trusses. A single building, say 500-ft long and 150-ft wide was normally considered an exceptionally large project.

Lighting usually consisted of 200 to 500 watt RLM reflectors units. In some of the higher bays, 750 or 1000 watt units were used. Mercury vapor units were installed where the requirements of manufacture or product demanded higher intensities, etc. The 110-220-v, 3 wire distribution system was invariably common practice; whereas 220 or 440-v, 3-phase current was used for the average power equipment. Larger horsepower equipment of course makes the use of 23-v power supply mandatory.

The modern aircraft assembly and parts plant buildings have exceeded dimensions heretofore believed beyond comprehension. The Consolidated Vultee Aircraft Corporation assembly building at Fort Worth is nearly a mile long, more than 300-ft wide, 40-ft clear height under trusses, with the main clear span 200-ft wide. The parts plant building is about a half-mile long, more than 300-ft wide with mezzanine area throughout most of the building. This building joins the assembly building as one single building. Recently a 300 by 300-ft clear span building with 60-ft clear height under trusses was completed at this plant site. These are just typical examples of building proportions that may have been construed as a dream before the war.

Lighting for buildings of this magnitude presented a comprehensive task for the engineer. The problem of providing suitable lighting units, operating voltage, electrical distribution, and wiring with all component incidental details of mounting lights at a height of 40-ft above the floor was without precedent.

An extensive study and analysis was made to determine the most prac-

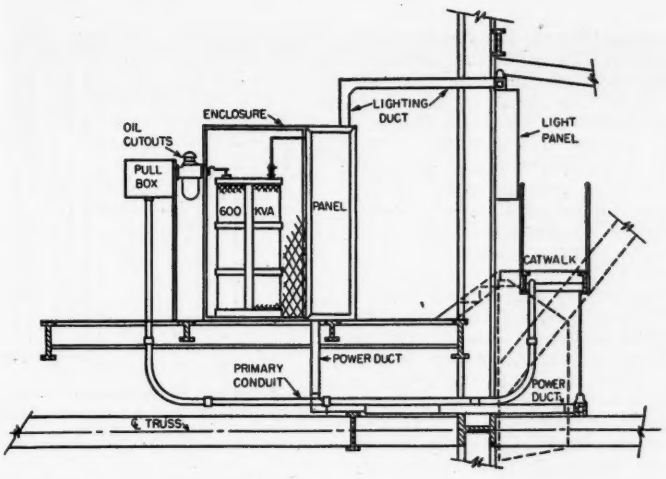
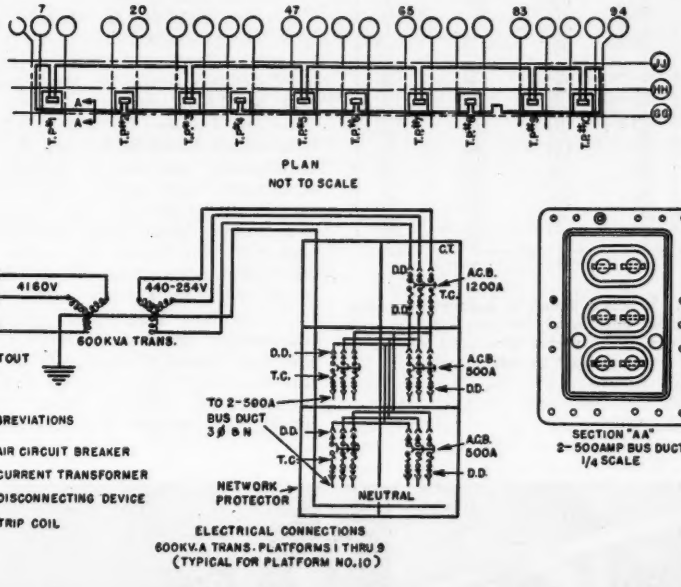


Fig. 2. (Above) Typical unit substation used in assembly building area

Fig. 3. (Right) Diagram of the Parts Plant network loop system



tical system voltages, distribution equipment, and lighting units suitable for aircraft assembly production.

The Texas Electric Service Co. serves the plant with electrical energy at 60,000-v. Two outdoor substations, each consisting of high voltage switching equipment and three single phase O.I.S.C. 3333 kva transformers step the voltage down to 4160-v, 3-phase, 4-wire. Outdoor type of switchgear is used to distribute 4160-v, 3-phase, 4-wire current to the unit substations throughout the plant area.

The unit substations in the assembly and parts plant buildings are located in the truss space, 40-ft above the floor. Each unit substation consists of one 600 kva, 3-phase, 4160/2400-v primary, 440/254-v secondary, air cooled transformer, oil type disconnects on the primary and an 800-amp, 3-pole, 600-v, air circuit breaker on the secondary side, with Saflex panels for the assembly building. 1200-amp, 3-pole, 600-v, air circuit breakers are used on the secondary side of transformers for the network protective system in the parts plant building. Figure 2 shows a typical unit substation used in assembly building.

In the assembly building a radial system is used for power and lighting distribution. The switching equipment consists of Saflex panels to distribute 440-v, 3-phase current to the air conditioning units located in the truss space, 440/254, 3-phase current to lighting equipment and 440-v to the 50 kva, 3-phase, air cooled transformers, and 440-v, 3-phase power panels. These 50 kva transformers are located on columns above a power panel which serves the underfloor duct and small tool power racks with 120/208 single phase voltage. Square duct, conduit and RH wire is used to distribute 440-v from unit substations.

In the parts plant building a protective network loop system with bus duct is used to distribute 440/254-v, 3-phase. The network loop system is protected with 500-amp, 3-pole air type circuit breakers, connected to the twin 500-amp bus ducts. Since the parts plant is primarily a parts manufacturing and machine tool area, a 1000-amp bus duct consisting of 2-500-amp, 3-phase, 440/254-v circuits (round copper tubing) serve the area above and below mezzanine, air conditioning units, lighting equipment, and small tool power transformers. Plug-in type of fused switches, conduit and cable are used to extend the respective services from the bus

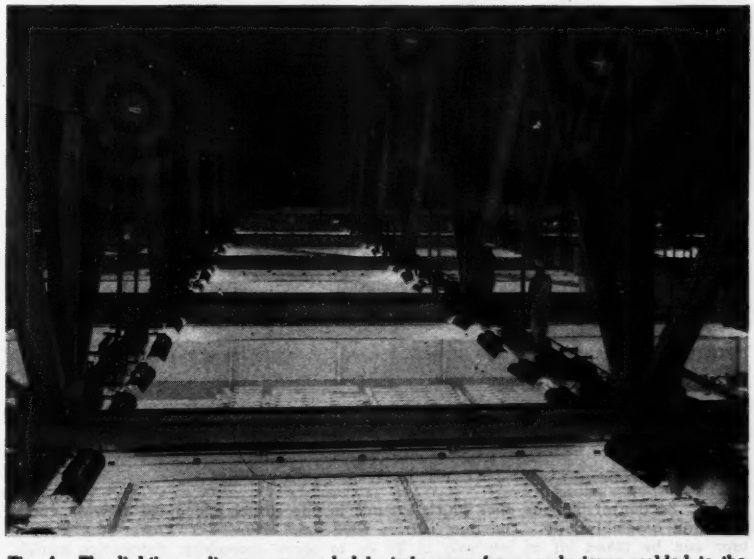


Fig. 4. The lighting units are suspended in twin rows from angle irons welded to the steel trusses. These beams are on 25 ft centers along the length of the building and are 40 ft above the main floor level

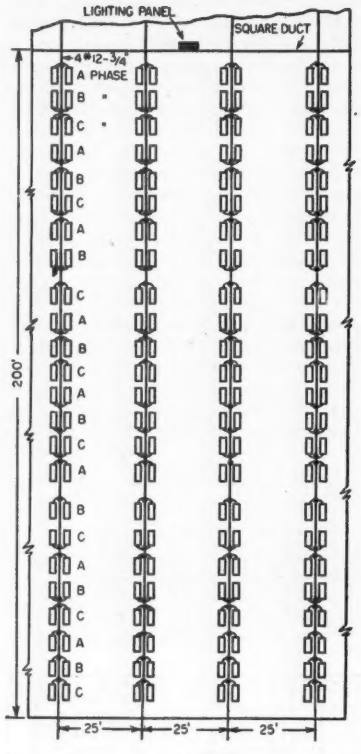


Fig. 5. Each circuit is balanced by connecting each group of two lighting units to one of the phase wires and neutral as indicated in this drawing

duct to equipment. The bus duct with plug-in switches, permits a flexible arrangement of extending electrical service to any point in the Parts Plant. Figure 3 illustrates the parts plant network loop system.

To provide the needs of small power tools, used throughout the assembly building area and also certain sections of the parts plant first floor, 120/208-v single phase current is available from underfloor duct outlets. The underfloor duct system consists of General Electric Company fibre duct and outlets are spaced on about 25 by 25-ft centers. Power is supplied from the unit substations at 440-v to 50 kva transformers located on columns above 3-phase, 120/208-v circuit breaker panels. From the panels, conduit is connected to the underfloor duct system.

For the lighting, General Electric type RF fluorescent fixture with two 85 watt lamps was selected as the most desirable unit for this application, on the following basis:

1. The 3-phase, 440/254-v distribution system could be utilized, thereby eliminating additional transformer equipment, and considerable saving in conduit, copper and panelboards.

2. Planes have large surfaces of high reflection factor due to the fact that aluminum, magnesium and/or other bright metals are used.

3. The low brightness source of fluorescent fixtures overcomes the blinding hazard of employees looking into the bright light sources of highly concentrated lighting units when working on the side of planes and directing their line of sight in an upward direction.

4. Fluorescent lamps produce less sharp shadows than highly concentrated light sources.

5. In a large area, it is reasonable to use widespread distribution fixtures because the utilization of light output is fairly high. In other words, even with a wide spread reflector, the utilization efficiency is almost the reflector efficiency.

6. Wide spread reflectors provide a high degree of vertical illumination, which is very important, when work on a plane assembly will vary anywhere from a few feet above the floor to a height of 30-ft or more, depending on type of plane assembled.

7. A more uniform level of illumination is obtanied.

8. Lower operation and maintenance costs.

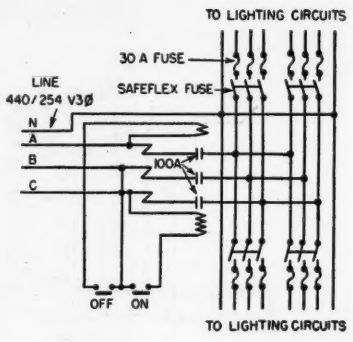


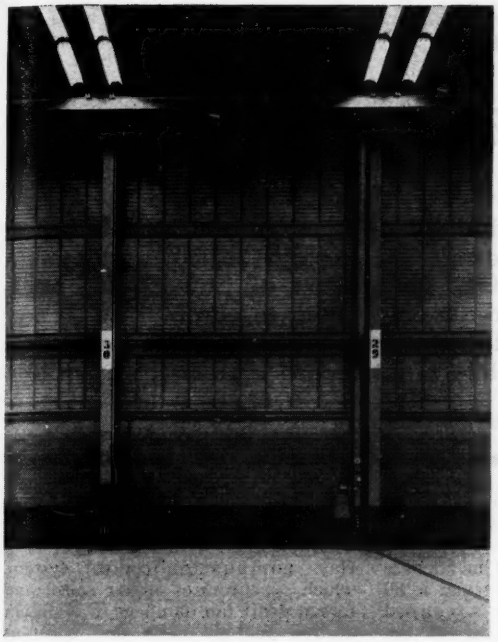
Fig. 7. Typical wiring diagram of the lighting circuits controlling 4 circuits of lighting shown in Fig. 5

Before the mezzanine area of the parts plant was completed, limitation orders imposed by the War Labor Board prohibited manufacture of the type RF fluorescent fixtures and it was necessary to resort to two-lamp Type F 100 watt lamp fixtures with metal and non-metallic reflectors of Sylvania Electric Products manufacture. Figure 1 shows a section of assembly building area.

As stated in the foregoing, 3-phase, 440/254-v was established as the operating voltage for the lighting systems. Where incandescent lamps are used, connection is made from the small tool power panels where single phase, 120/208-v is available, or from a small air cooled transformer at unit substation when required. One can easily visualize the saving involved in conduit, copper, panelboards, hangers, transformers, main switches, labor, etc., over conventional 110-220-v system, especially when the length and width of runs are considered.

Figure 4 shows a typical layout of lighting units for a 100 by 200-ft area. Each row of lights are connected to a 3-phase, 440/254-v branch circuit controlled by a magnetic contractor as shown in Fig. 7 wiring diagram. Each circuit is balanced by connecting each group for two lighting units to one of

Fig. 6. Section of the bus duct which extends in one stretch along the catwalk above the main assembly bay. The duct carries 1000 amp. 440-v a-c. Power and lighting taps can be taken off at intervals of 20 in. to serve secondary distribution panels. The panel shown here serves lighting fixtures covering an area of 45,000 sq ft. By locating the boxes as close to the bus duct as possible, the only wire over No. 12 gage is in feeders between the bus duct and distribution panel, in all cases only a few feet



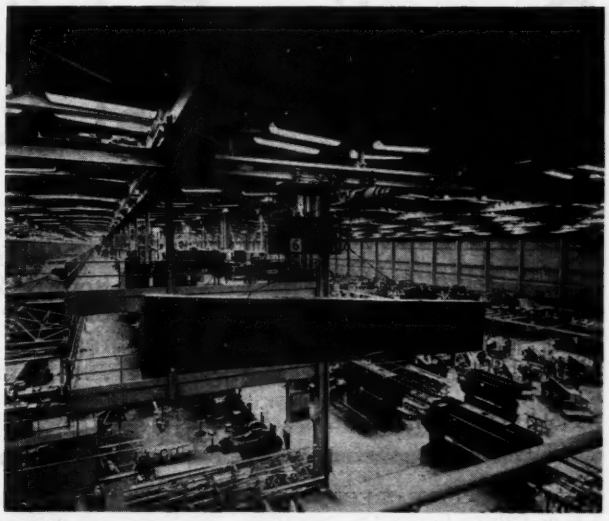


Fig. 8 (Above) Monorail operating in cross-over aisle between cantilever and mezzanines; passing from the 120 ft to the 200 ft bay

Fig. 9 (Left) View showing the installation of lighting control panels on building columns

the phase wires and neutral as indicated in Fig. 5.

Figure 7 shows a typical wiring diagram of the lighting circuits, controlling 4 circuits of lighting shown in Fig. 5.

Three-phase, 440/254-v energy is available from the unit substation main switchboard panel in the assembly building and from the network loop bus duct in the parts plant building. The branch circuit is connected to a 100-amp, 440-v, 3-pole mechanically held contractor with 440-v operating coils which in turn feeds two or four 30-amp, 3-pole branches. The 30-amp branches are connected to the distribution circuits. All of the above mentioned control equipment is mounted in a metal cabinet and is located along the catwalk above the trusses. Operation of the lights is effected by a single pole momentary contact push button station, mounted on respective columns about 4 ft-6 in. above floor. This push button station actuates the 440-v operating coil of the contactor, which in turn allows current to flow to the branch, and distribution circuits and lamps.

Figure 10 shows cross section of method of supporting fixtures in the assembly building from lower chord and trusses. The brackets are raised or lowered to maintain 10½ in. dimension and alignment from the center line of trusses to suit the range of WF members used in the trusses. The sections vary from 14 in. WF—38 lb to 176 lb.

The fixtures are furnished with an amphenol plug and receptacle. From the receptacle, flexible type SJ cord is connected to the respective circuit in the condulet fitting.

Two lamp ballasts for the Type RF and F lamps were supplied to operate within a voltage range of 225 to 275-v with a mid-point of 255-v. The current per two lamp RF fixture is approximately 0.9-amp, whereas the type F unit with 2-100 watt lamps consumes approximately 0.925 amp. The 3-phase distribution circuits are balanced by connecting an equal number of lamps to each phase circuit.

Maintenance of the fixtures and lamps is accomplished from the overhead monorail cranes which covers practically the entire areas of the assembly and parts plant buildings. The fixtures are furnished with a 3-pole disconnecting plug and receptable and therefore may be removed or replaced without disturbing the wiring. The lighting of these buildings has been acclaimed to be an outstanding achievement and materially considered an asset in the production of aircraft for the war effort.

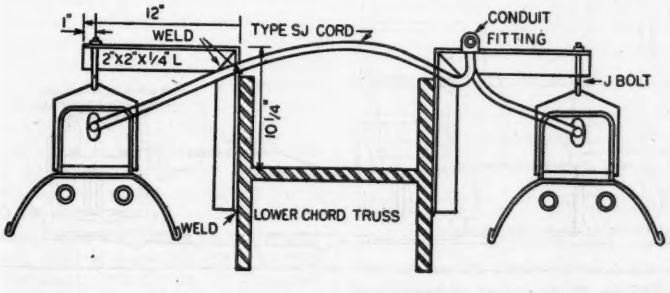


Fig. 10. Cross section showing method of supporting fixtures in the assembly building from lower chord of trusses

Invisible Searchlight Beams

Ultraviolet screens of dark purple glass are used by the Signal Corps to transform searchlight beams into invisible "light." Used in connection with cloud-height finding devices, these screens filter out all visible light from the tiny but powerful match-shaped mercury lamp, which operates at so high a temperature that it must be constantly air cooled. The screen sometimes reaches temperatures far exceeding that of boiling water, and is therefore built in small planes to localize shock caused by exterior temperature changes.

The complete cloud-height determining system, which consists of a ceilometer, light projector, and special recorder, was designed by the U. S. Weather Bureau in conjunction with illuminating engineers. The invisible beam is shot up to the cloud base by the projector. The ceilometer, actually a photoelectric scanning device, indicates the location of energy reflected from the cloud base. The ceiling height is then computed by triangulation.—G. E. Review.

Operating Details at Ralston Purina

By Ralph H. Vidal

Assistant Superintendent
(Formerly Power Engineer)
Ralston Purina Co., Battle Creek, Michigan

Plant serving famous food products industry at Battle Creek . . . Generates 20,000 lb steam an hour at 200 psi; purchases all power . . . Details of water treatment system to eliminate CO_2 corrosin in plant piping . . . Lubrication schedules . . . Complete plant record system for operation

As told to CHESTER R. EARLE, Associate Editor, Power Plant Engineering

AT THE BATTLE CREEK PLANT of Ralston-Purina Co., operating problems of the past few years have been typical of those encountered in relatively small power plants in all industries. Some account of what we have done to solve them should, therefore, be of interest to many engineers. One principal problem has been in securing proper feedwater treatment. Another has been to maintain service to the manufacturing process under the prevailing war-time conditions. We also have a rather comprehensive record system, which has aided us in analyzing and improving our operations and which should be of interest to power engineers.

Our manufacturing operations require an average of about 12,000 lb of steam an hour for processes and space heating, compressed air, some process water and about 500,000 kwhr of electricity a month for motors, lighting and processes.

General Plant Layout

To supply these, our power plant is laid out as shown in Fig. 1. Steam is generated by two Erie City Iron Works 3-drum, low-head type steam generating units, designed for 200 psi gage operating pressure, saturated steam temperature of 388 F. These units are fired with coal burned on Detroit Roto stokers. The units were originally designed for a fuel of the following characteristics:

Btu per lb	14,800
Sulphur	0.65 per cent
Moisture as received	2.5 per cent
Ash	2.5 per cent
Volatile	30.0 per cent
Fixed Carbon	65.0 per cent

Of course, under present war-time conditions, we take whatever coal is available. The coal is delivered in hopper bottom cars on a railroad siding alongside the plant. From the track hopper it can be delivered to an outdoor storage pile or direct by a Link-Belt drag conveyor and elevator to 300-ton overhead bunkers above the firing aisle. From these a Richardson weigh larry distributes it to the stokers. Ash is discharged from the stoker ash hoppers by a United Ash Conveyor system.

The fly-ash is collected in hoppers at the rear of both boilers and is 80 per cent pure carbon. This is returned to the combustion chamber at the rear of the settings with a special steam injection type nozzle. This fly-ash is burned only during the ash cleaning period and most of the time there is enough heat available in the fly-ash to maintain normal steam pressure while ashes are being removed, with only one stoker at a time in operation.

Forced draft for each boiler is produced by a Buffalo motor-driven forced draft fan. No induced draft fans are installed.

Combustion is under control of a Hays combustion control system, which synchronizes stoker speed and forced draft fan dampers to maintain desired fuel-air ratio and constant steam pressure. The combustion control system is electrically operated and its power supply is taken from a separate small power transformer so that a lighting circuit interruption in the power plant will not affect the control operations.

Low Coal Alarm

Another convenient feature on the coal handling system is the low-coal-in-the-stoker-hopper alarm, shown in

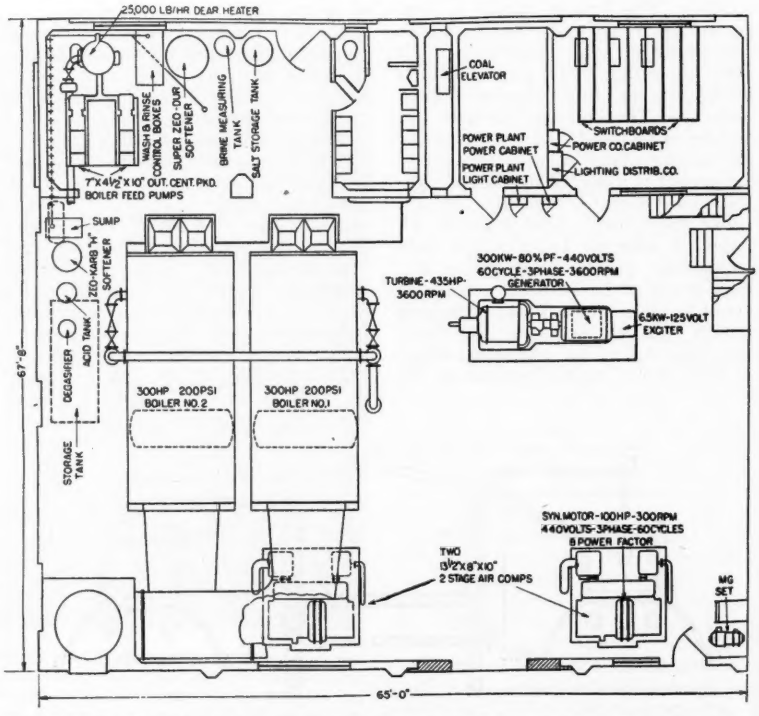


Fig. 1. Plan of Ralston Purina Co. power plant, showing how boilers, air compressors, and all auxiliaries are conveniently arranged on one level

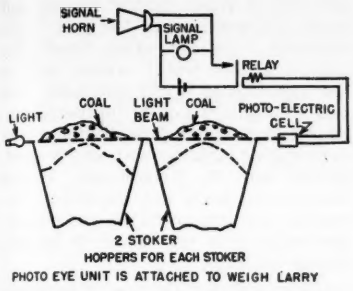


Fig. 2. Diagram showing how "electric eye" is used to warn operators of low coal in stoker hoppers

Fig. 2. While not a new idea, the operators find it useful. The stoker hoppers are well above eye level, and to determine when the coal level in the hoppers is getting low, the operator would have to mount a platform or ladder regularly, or a mirror would have to be used over the hopper, as in many plants. In our plant, an "electric eye" does this job. A photo-cell and light source are mounted on the weigh larry so that the light beam energizes the photo-cell when the coal level drops below the top of the hopper. The energized photo-cell actuates a signal light and horn, warning the operator of a stoppage in coal flow from the bunker to the hopper. Since there are two stoker hoppers per boiler, there is no danger of one side of the stoker running out of coal without warning. This device saves many steps, a valuable thing in these days.

In the plant is installed a small extraction turbine-generator set, formerly operated to supply 30-psi extraction steam to processes but now inoperative and held for standby because the process steam conditions and steam-electric balance have changed since it was installed. All electric power used in the factory is now purchased from the local utility.

This turbine generator set consists of a 435-hp Kerr turbine operating at 3600-rpm, direct-connected to a 300 - kw, 0.80 - pf, 440 - v, 3600 - rpm, 3-phase, 60-cycle Allis-Chalmers generator, with a 5-kw exciter mounted on the shaft. The turbine is equipped with a Worthington surface condenser.

To supply compressed air, we have two motor-driven air compressors. These motor-driven units are Ingersoll-Rand 2-stage horizontal units, 13½ by 8 by 10 in., each driven by a 100-hp Electric Machinery Mfg. Co. synchronous motor. In the plant basement are located deep well pumps, water service pumps supplying the factory, fire pump, compressed air receivers and the like. The boilers, air compressors and other auxiliaries are all on the main floor as shown.

Water for process work and boiler feed is pumped from deep wells, softened in a Permutit zeolite softening system, heated in an Elliott 25,000-lb per hr deaerating feedwater heater and pumped to the boilers by either of two Gardner-Denver 7-by-4½-by-10-in., outside center-packed reciprocating feed pumps.

Development of Water Treatment System

The development of our water treating system brings out points that many engineers seem to be seeking information about nowadays.

When our plant was first built in 1937, it was equipped with a standard Permutit sodium zeolite water softener, which was entirely satisfactory and is still part of the system.

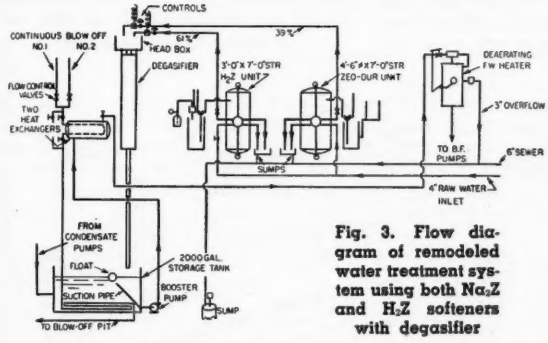


Fig. 3. Flow diagram of remodeled water treatment system using both Na_2Z and H_2Z softeners with degasifier

However, as time passed, we began to have corrosion in our piping and heating systems and traced this to the presence of free CO_2 in the raw water. Accordingly, after considerable study by our company's engineers and those of Permutit Co., the system was remodeled to add a hydrogen zeolite softener to the sodium zeolite unit, feeding sulfuric acid as required and degasing to remove the CO_2.

Raw well water tests in 1938 showed (all valves in ppm):

Total Hardness (as $CaCO_3$)	464 ppm
Calcium Hardness (as $CaCO_3$)	344 ppm
Magnesium Hardness (as $CaCO_3$)	120 ppm
MO Alkalinity	352
Basicity to Phenolphthalein	0
Sodium Alkalinity	0
Free Carbon Dioxide	25
Chlorides	76
Sulfates (Na_2SO_4)	248
Theoretical Mineral Acidity	240
Free Mineral Acidity	206
Cations to be removed	558
Total solids	676

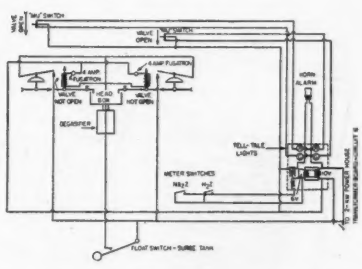
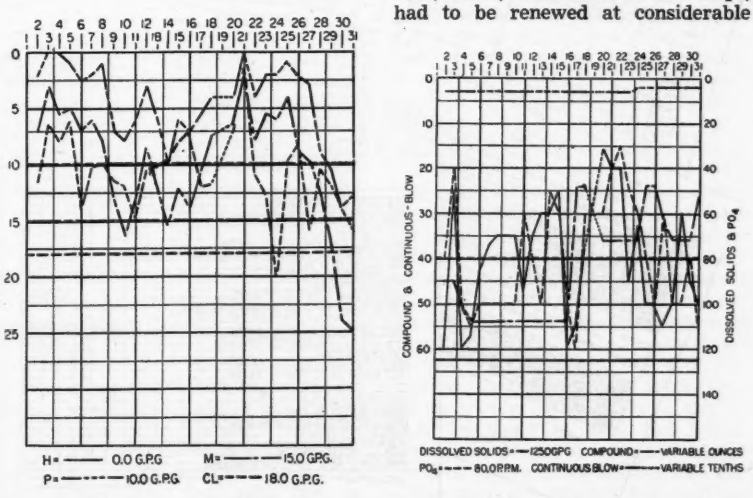


Fig. 4—Right. Wiring diagram of water softener control; flow stoppage in softeners or filling of storage tank closes effluent valves

Secondary liberation of CO_2 in the boilers caused corrosive condensate, which in turn caused corrosion in the return lines. In one old building alone, the return lines were practically all badly corroded or filled with rust; these, with most of the traps, had to be renewed at considerable


2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
0 5 10 15 20 25
H= —— 0.0 G.P.G. M= — — — 15.0 G.P.G.
P= - - - - 10.0 G.P.G. CL= - - - 18.0 G.P.G.
COMPOUND & CONTINUOUS BLOW
DISSOLVED SOLIDS & PO₄
0 10 20 30 40 50 60
0 20 40 60 80 100 120 140
DISSOLVED SOLIDS= —1250GPG COMPOUND= —VARIABLE OUNCES
PO₄= - - - 80.0 P.P.M. CONTINUOUS BLOW= ——VARIABLE TENTHS

Figs. 5A and B. Charts of boiler water analysis for January, 1941. Horizontal lines show recommended values to be maintained. Zero at top of chart; higher curves go, the closer everything is to neutral. Grains per gallon × 17.15 = parts per million. Parts per million × 0.0583 = grains per gallon

expense. To remedy these conditions, the water treatment system was amplified to that shown in Fig. 3. In doing this, the question of space for additional water treatment equipment in the existing power plant space had to be considered. The equipment was finally installed in the locations shown in Fig. 1.

H_2Z Softener Added

To the original sodium zeolite softener we added a hydrogen zeolite unit, with acid tank and degasifier. A 2000-gal storage tank for treated water was installed below in the basement. At present, our make-up water to be softened averages 800 gph or about 20,000 gal in 24 hr. We put 61 per cent of this water through the hydrogen zeolite softener, 39 per cent through the sodium zeolite unit. The two streams of water then flow to the degasifier, as shown in Fig. 3, and thence to the storage tank. The hydrogen zeolite unit is regenerated by the acid process to operate on the hydrogen cycle.

The sulphuric acid is delivered to our plant in 600-lb steel drums. We have a stationary rack provided with a portable ramp where we place the drum and the acid is transferred from the drum to the acid crock by 3-lb air pressure, with a 5-lb air relief valve to protect the steel drums. One filling of the acid crock is sufficient for six regenerations.

Continuous blowdown equipment with two heat exchangers is provided for the boilers and the blowdown water flows through a coil in the storage tank, giving up the last of its heat to the stored water before flowing to the blow-off pit.

Control System for Amplified Treatment System

We worked out an automatic control for the water softeners as shown in Fig. 4. The final control of the two waters in this system, we believe, is just as important as the units themselves, for the following reasons. Since acid is added at the hydrogen zeolite softener unit to 61 per cent of the water, this water *alone* might be highly corrosive if it got into the boilers, although the H_2Z effluent was guaranteed to contain not over 1½ per cent of H_2SO_4 during rinsing and about 0.02 per cent or 186 ppm while softening. On the other hand, the sodium zeolite water, *alone,* carries the high CO_2 as it did originally, and this CO_2 would not be properly liberated in the degasifier without the neutralizing acid-treated water combining with it. Accordingly, unless both water flows are carefully controlled, one slip-up might put enough acid water into the boilers to be definitely harmful.

We questioned the use of bypasses on the two softeners to be used in regeneration, for the same reasons, and no such bypasses were installed.

Instead the control system is arranged so that if the pressure in either effluent line from the two softeners drops below 10 psi, indicating a decrease in flow from either unit, or if the float in the storage tank should reach a maximum pre-determined high level, the flow of effluent from both softeners would stop but the influent flow to the softeners would be uninterrupted, so that wa-

(Continued on page 128)

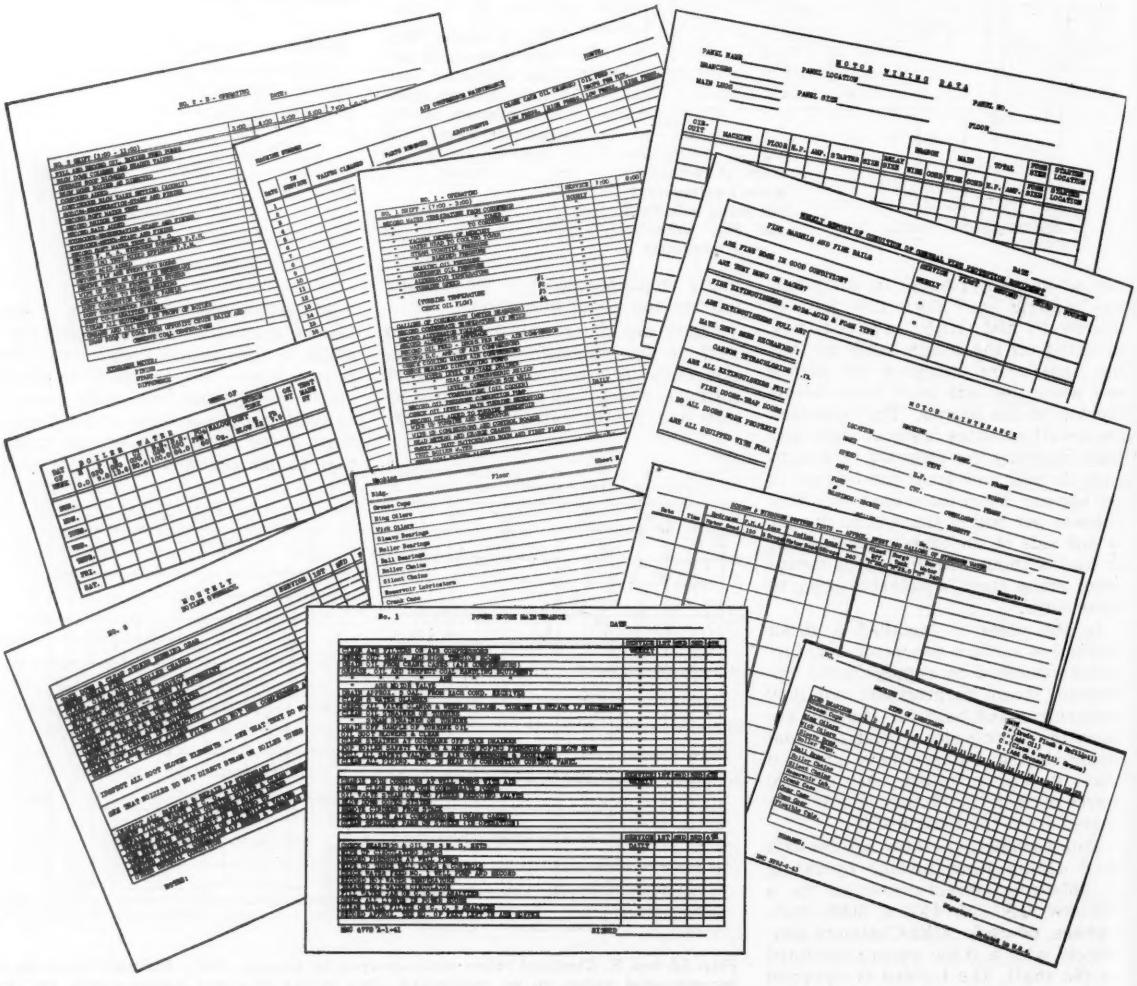


Fig. 6. Record forms for process machine, motor, wiring and general power house maintenance; check sheets for shift operations, inspections and overhaul; lubrication routine

Pressure Loss in Steam Lines*

By C. D. Gibbs

The chart on the two following pages is one of the handiest we have seen in a long time. It gives you everything you need to know about pressure drop in steam lines in terms of three simple variables; the flow in pounds per hour, the specific volume of the steam, and the size of pipe. The only "outside" information you need is the specific volume of the steam and that is easily obtained from steam tables available in almost any handbook. The chart is simple to use and it should be of help to every engineer in working out piping problems. Keep the chart for future reference.

METHODS of determining the drop, or loss of pressure, in steam lines have been developed in many ways; numerous curves, alignment charts, and tables have been developed to facilitate obtaining this drop from the primary data. Most of these methods are based upon the equation:

$$\Delta p = f\ (L/D)\ (\rho V^2/2g)$$

which, in circular pipes, becomes:

$$\Delta p = 0.001295\ f\ (L/d)\ \rho V^2$$

This equation makes use of a friction factor "f" which is obtained from a chart for different kinds and conditions of pipe, and from Reynold's number for the particular steam conditions.

$$\text{Reynold's number} = \rho Vd/\mu$$

In order to determine the pressure drop by calculation it is necessary to know the following:

L = length of pipe in feet
D = internal diameter of pipe in inches
ρ = density of the steam in pounds per cubic foot
μ = absolute viscosity in pounds per foot second
V = mean velocity in feet per second

Actually, all the engineer knows is the initial pressure, the weight of steam required, the effective length of pipe, and the size of the pipe for an existing line; or, the initial pressure, the weight of steam required, and the permissible pressure drop. All other terms in the equation must be calculated from these data or obtained from charts or tables. The work of calculating is involved; some of the simplified methods which have been presented are also involved, and errors are easily made unless the calculator is thoroughly familiar with the method.

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The chart submitted here has reduced the variables to three: The flow in pounds per hour; the specific volume; and the size of the pipe. The only external work required is the determination of the specific volume, from a steam table, corresponding to the initial steam pressure and temperature. The pressure drop, in pounds per square inch per 1000 feet of pipe, is obtained from the chart as shown by the heavy dashed line. The total drop is obtained by multiplying this figure by the effective length of run in thousands of feet.

The chart finds application in both types of problems previously mentioned; its application is illustrated by the following examples:

Example 1: Pipe 6 inches, 1200 feet effective length, 215 psi gage D & S steam, 40,000 lb per hr flow required. Find the terminal pressure: From the steam table, the specific volume is found to be two. Proceed vertically from 40,000 lb per hr to the specific volume line 2; then horizontally to the 6 inch pipe line; then vertically to the pressure drop scale. The drop is found to be 20.5 lb per square inch per 1000 feet. The total drop is: 1.2 x 20.5 or 24.6 lb per sq in.; the terminal pressure is 215 minus 24.6, or 190.4 lb per sq inch.

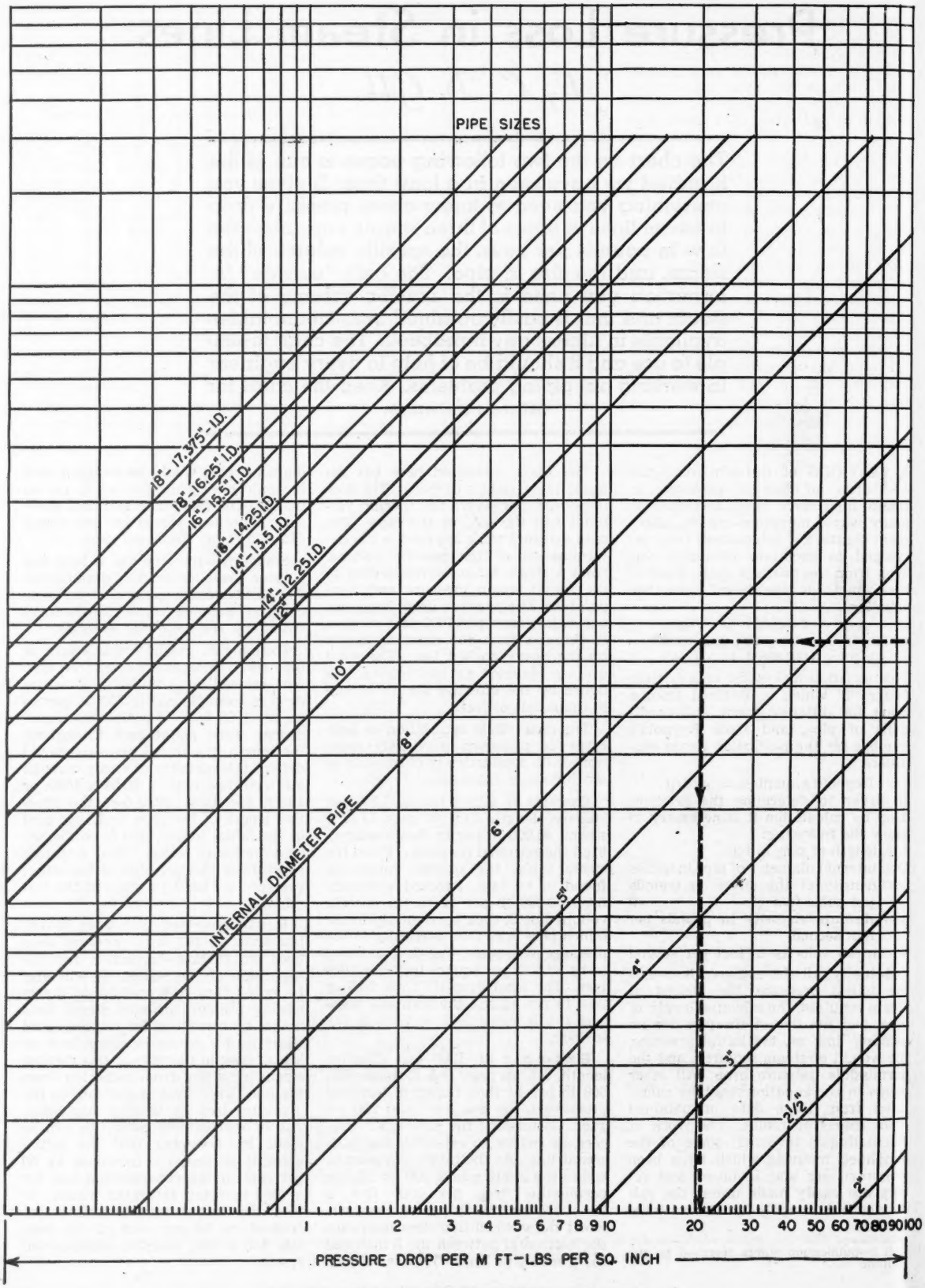
Example 2: 1200 feet effective length, 215 psi gage D & S steam, 40,000 lb per hr flow required, terminal pressure to be not less than 200 psi gage. Determine the pipe size: Proceed as before to establish the horizontal line. As the maximum permissible drop is 215 minus 200, or 15, the permissible drop per 1000 feet is 15 ÷ 1.2, or 12.5 lb per square inch. Erect the vertical line; this intersects the horizontal between the 8 inch and the 6 inch pipe lines. Thus, an 8 inch diameter pipe would be required, and it would have a drop of 5.1 lb per sq in. for 1000 feet. The terminal pressure, therefore, would be: 215 minus (1.2 x 5.1) or, 208.88 psi gage.

Sometimes the pipe line is long and a large pressure drop is permissible. For this condition a per cent pressure chart is included whose use is illustrated by the following example:

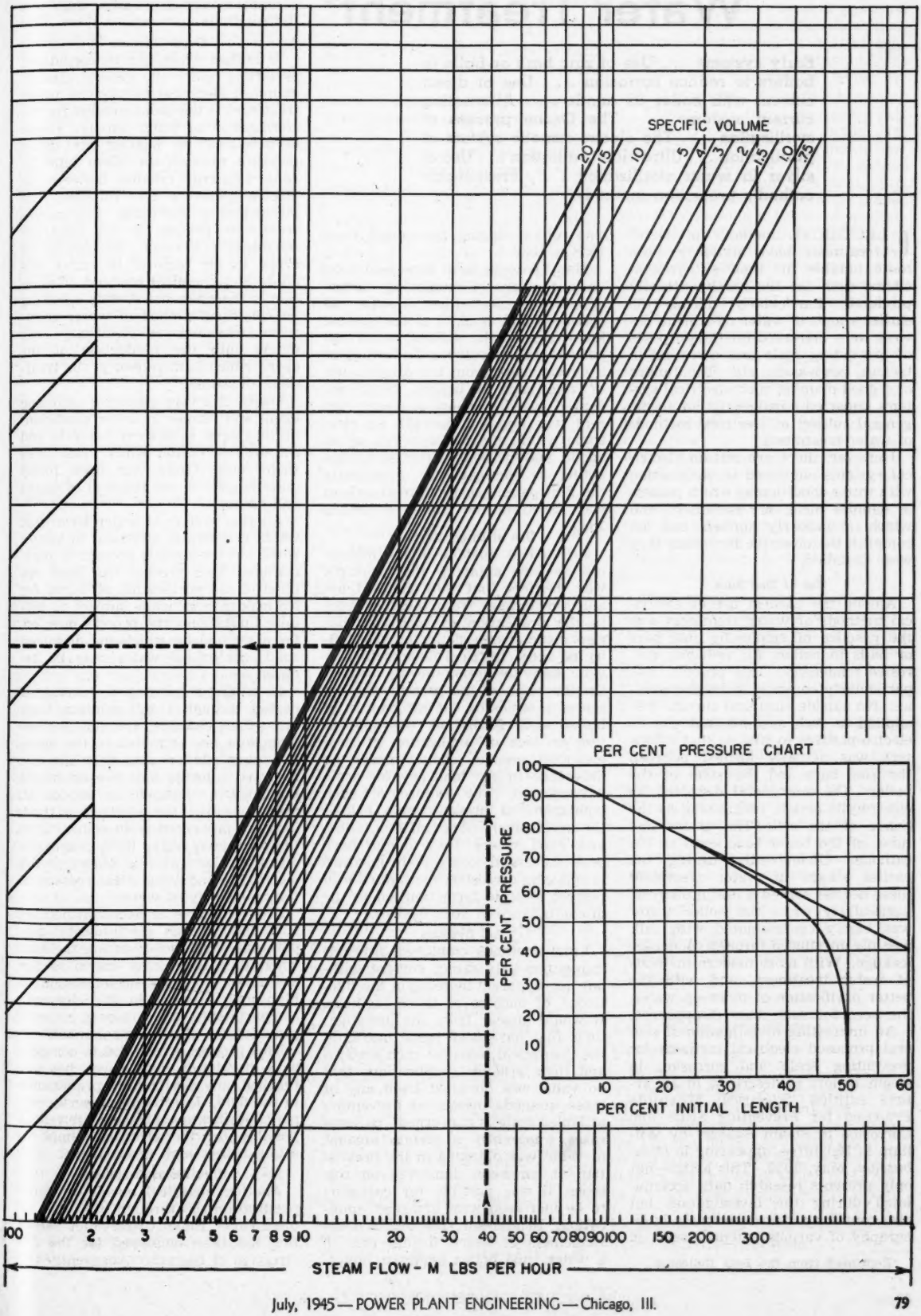
Example 3: Assume the length of pipe given in Example one to be 4200 feet instead of 1200. The pressure drop in example one is 20.5 lb per sq in. per 1000 feet. If initial steam conditions were maintained throughout the length, the initial pressure would deliver this quantity of steam through a 6 inch pipe (215 ÷ 20.5) x 1000, or 10,490 feet long. 4200 feet, the effective length of the pipe, is 40 per cent of the initial length, and from the per cent pressure chart, the resulting pressure is 56.5 per cent of the initial pressure or, 121.3 psi gage at the terminal.

It will be noted that lines having less than 20 per cent pressure drop need no further correction for the expansion of the steam. It will also be noted that this method of determining pressure drop in steam lines makes no correction for the increased quantity due to condensation loss, or loss of heat in the case of superheated steam, resulting from radiation from the line. The effect of this loss on the pressure drop is usually negligible, but an approximate correction can be made by assuming that the initial quantity of steam is increased by 50 per cent of the condensation loss for a line carrying saturated steam; or that the initial temperature is increased by 50 per cent of the heat loss for a line carrying superheated steam.

CHART FOR DETERMINING THE



PRESSURE LOSS IN STEAM LINES



Electrical Methods of Water Treatment*

Early systems . . . Use of zinc bars or balls in boilers to reduce corrosion . . . Use of direct current with boiler as anode . . . Alternating current systems . . . The Ozone process of sterilization . . . The electro-osmotic system of purification . . . Ultra-violet radiation . . . Use of silver in water sterilization . . . Present-day cathodic protection methods.

ELECTRICAL methods of water treatment have usually been more notable for their extravagant claims than for the results actually produced. Particularly during the earlier stages of water treatment, devices were marketed for the purposes of preventing scale and corrosion in boilers, condensers, etc. The failure of a good many of such electrical systems imparted a bad reputation to the general subject of electrical methods of water treatment.

However, there are certain electrical systems employed in conjunction with water conditioning which possess a definite field of usefulness and which, if properly applied, can accomplish the objective for which they were installed.

Use of Zinc Bars

Among the earliest use of electrical methods of water treatment was the practice of employing zinc bars or balls in boilers for reducing corrosive tendencies. This practice was particularly common in marine service. No outside electrical current was applied to such systems, but zinc is electro-positive to iron so that a battery was actually formed between the zinc bars and the steel of the boiler. The zinc metal dissolved by electrolytic action, functioning as the anode of the cell. The drums and tubes of the boiler functioned as the cathode. Undoubtedly, during the earlier stages of water treatment these devices served a useful purpose, particularly when the boiler water was highly contaminated with salt, possibly introduced through condenser leakage. With more modern methods of water treatment, and with the better purification of make-up water, the need for such units disappeared.

An interesting investigation of several proposed electrical methods for preventing scale and corrosion in steam boilers is described in an article entitled "Electrical Methods Proposed for Preventing Scale and Corrosion in Steam Boilers" by William L. Rebaufre, appearing in *Combustion*, May, 1932. This article not only presents research data accumulated during the investigation but also contains a rather complete bibliography of various patents issued on this subject during the period from 1858 to 1932.

Many patents have been issued on various means of employing electricity for the prevention of scale and corrosion and, in light of the present knowledge of the subject, many appear to be ridiculous. Following as a development from the original use of zinc bars in boilers, there appeared systems where a direct current was imposed between an electrode within the boiler acting as an anode, and the boiler drum and tubes acting as the cathode. Apparently the first patent on such arrangement was issued in the United States in 1869.

Use of Direct Current

An evident mistake of the numerous systems applying this principle was the fact that they claimed not anly advantages from these systems in the prevention of corrosion, but also made strong claims on the ability of such electrical devices to prevent scale formation in the boilers. On the basis of the present day accepted theories on the mechanism of boiler scale formation, the application or lack of application of such electrical control should make no difference in the tendency for scale development. The failure of such equipment to prevent scale caused the development of a bad reputation, and even where they might have been successful to a certain measure in reducing corrosion, the failure with respect to scale formation led to the discontinuance of such devices.

A-C Systems

Later methods employed alternating rather than direct current without any apparent increase in the likelihood of success of these methods. It would appear from the investigations that have been made into both the theoretical basis for such systems and their practical applications that no value was obtained from any of these methods insofar as prevention of boiler scale is concerned. In some cases, apparently a certain amount of value was obtained in the prevention of corrosion, but even on this score, it was possible for corrosion to be increased with improper application. In addition, the involved arrangement of tubes, drums, etc., in a water tube boiler makes it impossible to provide a uniform current density over the entire surface. Under such circumstances, the application of these electrical methods may accentuate corrosion rather than help the condition.

Ozone Process

A method which can be considered as falling under the general classification of electrical methods of water treatment is the ozone process for the sterilization of water supply. Ozone is produced by passing air under pressure through the silent blue corona discharge created between dielectric plates at high voltages. The production of the ozone used in this treatment process is an electrical operation. However, the action of ozone in the removal of tastes and odors is a chemical reaction. Ozonation is therefore not strictly speaking an electrical method of water treatment, inasmuch as electricity only enters into the production of the ozone which is then used in the treatment of water.

Ozone is a very powerful oxidizing agent and its use in water conditioning has been to destroy bacteria and the organic matter which constitutes their food. Ozone has been found quite helpful in the removal of tastes and odors.

Another system of water treatment which is basically electrical in nature is the electro-osmotic process of purification. This process has been applied to the purification of water for ice making and, while subject to definite limitations, the process does offer a method by which the dissolved solids content of water may be reduced.

If a direct electrical current is passed through a salt solution, such as sodium chloride, the positive sodium ions are attracted to the negative electrode or cathode while the negative chloride ions are drawn to the positive electrode or anode. If, after reaching the electrodes, these ions are prevented from returning to the main body of the fluid, eventually all of the ions will be drawn to the electrodes and very little remain in the main body of water.

This objective is accomplished by surrounding each electrode by diaphragms which act to retain the ions when they have been drawn to the electrode. To avoid accumulation of high ionic content in the electrode compartments, a continuous rinse is provided for these compartments.

This process is intended to compete with distillation but, as yet, has not reached any position of prominence in the field. In attempting very complete purification of the water, it is possible for the electrical input to attain rather high proportions.

Ultra-Violet Radiation

Another electrical means of water purification is through the use of ultra-violet rays. Ultra-violet radiation has been employed for the destruction of bacteria. Apparently the

*Reprinted from the Betz Indicator.

more lethal rays are those with wave lengths within 297 mu and 210 mu. The rays are apparently adsorbed by the body acted upon and the action is direct, causing their destruction. Data has been presented on the effect of these units in water sterilization but this process has as yet not reached any widespread use. Some application of ultra-violet sterilization has been made to swimming pool waters.

Another application of electrical methods to water treatment has been the use of metallic silver as a germicide. Heavy metals such as mercury, lead, gold, silver and copper attack living matter in general. Silver has been employed as a germicide to a greater extent than the other heavy metals since it is less toxic to higher forms of life. A method developed in Europe relies on the introduction of silver to water by passing the water between two metallic surfaces, the water to be disinfected acting as an electrolyte. Metallic silver constitutes the anode. An external application of direct current is placed between the electrodes and silver ions are dispersed into the flowing water. The amount of current employed is maintained below that necessary for the dissociation of water. In the process metallic silver is also deposited at the cathode.

The application of silver for water sterilization has not yet met with widespread acceptance in this country, although certain aspects of the process indicate this method to hold some promise for future development.

Cathodic Protection

Of the electrical methods in present day use, the cathodic protection of steel water tanks undoubtedly enjoys the greatest prominence. Cathodic protection has been applied to pipe lines to prevent external or soil corrosion and in recent years has been developed to the point where cathodic protection constitutes a generally accepted method of protectin tanks. A direct current of suitable voltage is applied to an anode in contact with the water in the tank and current is then circulated from the anode to the water to the tank. The metal of the tank itself is therefore the cathode in this circuit, and the applied electromotive force prevents the iron from going into solution. Usually the anodes are stainless steel or graphite suspended from the roof of the tank and insulated from the tank. The source of electric current supply is usually a transformer, a dry type of rectifier and various controls so that adjustment can be made in the current and voltage.

It has frequently been found that the installation of the equipment required for cathodic protection of a tank requires an installation cost less than the cost of painting the tank. The electrical cost for continuous protection is rather minor and this method of tank protection is gaining increasing acceptance.

External Corrosion of Furnace-Wall Tubes*

Part I—History and Occurrence

By W. T. Reid,[1] R. C. Corey[2] and B. J. Cross[3]

SINCE 1942, many large central-station boiler furnaces burning pulveried coal and removing the ash as molten slag have experienced external corrosion of furnace-wall tubes. In a few cases the loss of metal was so severe as to cause failure of tubes during operation, in others, seriously thinned tubes had to be replaced to prevent unexpected interruption of service. Because the rate of corrosion under certain conditions may be so high as seriously to weaken the tubes between normally scheduled inspections, operators charged with the continuous production of power under wartime emergency conditions have been greatly concerned over prevention of further corrosion.

To expedite the solution of the problem, a co-operative investigation was instituted between the Bureau of Mines and the Combustion Engineering Co. This report gives the results of the preliminary study of the occurrence of external corrosion, 16 furnaces in 15 stations being examined.

Corrosion was found to occur when the temperature of the tube metal was in the normal range for boiler furnaces, usually not exceeding 700 F, while the maximum temperatures observed were less than 900 F.

Deposits in corrosion areas are shown to be of two types, one having the appearance of a bluish-white porcelain enamel, being largely soluble in water in which it produces an acid reaction, and consisting principally of sodium and potassium sulphates in a complex form. The second type is iridescent blue or black, is insoluble in water, may contain significant amounts of carbon, and consists primarily of iron sulphide. Because of the greater incidence of the sulphate deposit, its study was made first and is reported in detail.

Part II—Significance of Sulphate Deposits and Sulphur Trioxide in Corrosion Mechanism.

By R. C. Corey,[2] B. J. Cross[3] and W. T. Reid[1]

To determine the mechanism of corrosion so that rational protective measures could be developed, an extensive laboratory study has been in progress since 1942 on the sulphate, or "enamel," deposits found on the tubes in areas where external corrosion occurs. These deposits are greenish-white to reddish-brown in color and are soluble in water, in which they produce an acid recaction. X-ray diffraction studies show them to consist primarily of a solid solution of sodium and potassium sulphates and alkali-metal ferric trisulphates, such as $K_3Fe(SO_4)_3$.

Experiments under controlled laboratory conditions with actual and synthetic "enamels" have shown that, at temperatures of 1000 F, sodium and potassium sulphates will react readily with iron oxide in an atmosphere containing a low concentration of sulphur trioxide to form the same alkali-metal ferric trisulphates that occur in "enamels." However, under the same conditions of temperature and concentration of SO_3 neither iron oxide nor the alkali-metal sulphates alone will react with SO_3.

These reactions suggest the mechanism of corrosion to involve the removal of the normally protective oxide on the furnace tubes by (a) the condensation on the relatively cool tubes of alkali-metal oxides which are converted to the corresponding sulphates by the SO_3 in the furnace, and (b) the subsequent reaction of the iron oxide on the tubes and the alkali-metal sulphates with the SO_3 evolved as the result of the slagging reactions in the coal ash deposited mechanically on the "enamel."

Thus conditions are afforded for the removal of the iron oxide on the tube with the formation of alkali-metal ferric trisulphates. Deslagging causes thermal decomposition of these compounds, and the cycle is repeated.

It is suggested that prevention of corrosion by this process can be achieved by ventilating the surface of the tubes with air so as to decrease the concentration of SO_3 below that necessary for the formation of the complex iron sulphates. Also, because the alkali metals required for the reaction are believed to originate principally from the flame, the addition of such air decreases the rate of deposition of alkalies. These findings are in agreement with field observations in which the maintenance of oxidiing conditions prevented further corrosion.

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*Abstract of a two-part paper presented under the auspices of the Research Committee on Furnace Performance Factors in cooperation with the Fuels and Power Divisions at the ASME annual meeting, New York, 1944. Full text of paper published in ASME Trans., May, 1945, Vol. 67, No. 4.

[1]Supervising Engineer, Fuel Section, U. S. Bureau of Mines, Pittsburgh, Pa.

[2]Research Chemist, Combustion Engineering Co., Inc., New York.

[3]Research Engineer, Combustion Engineering Co., Inc., New York.

Cold Water Deaeration—Correction

In the May, 1945, issue of POWER PLANT ENGINEERING, on page 128, Fig. 2 of the article entitled Cold Water Deaeration is printed with the top side down. Apologies are due to the author, C. E. Joos, and to our readers for this error which occurred in the last minute make-ready of the form. We suggest that you mark your copy of the issue correctly in order to avoid confusion.

Editor.

SELECTING THE MOTOR

Changes in conception of motor application . . . Single machines now have as many as 10 motors . . . The squirrel-cage induction motor—what it can do . . . Speed-torque characteristics . . . Torque under starting conditions . . . Heating effects in motors . . . Double deck motors . . . Multi-speed motors . . . Definite applications . . . Ventilation of motors and type of insulation . . . High temperature operation

THERE was a time when machinery electrification meant using a single motor to drive a machine instead of taking power from a line-shaft or some other prime mover. However, we have now reached the time when machinery electrification means much more. A single motor driving a complete machine is now the exception rather than the rule, and on the larger and more complicated machines 5 to 10 motors are not uncommon. The correct application of these motors as well as the associated control equipment and other auxiliary electrical devices to give the desired sequence of operation by means of complete cooperation between the electrical manufacturer and machinery builder is machinery electrification in the full sense of the word.

As a machine is simplified mechanically by applying motors to perform the various functions of the machine, it is quite logical to expect the motor to go through cycles of operation that have in the past been obtained by means of clutches gear changing mechanisms, or other mechanical and hydraulic devices. Where a wide range in speed is required, various forms of adjustable voltage drives making use of d-c motors, motor generator sets, or electronic rectifiers have been successfully applied. Many papers have been presented recently in regard to what can be done with wide speed range adjustable voltage drives of various types, and undoubtedly this phase will be covered further in papers to be presented at this conference. However, there are many applications where a wide range in speed is not required, and it is desirable to consider what can be accomplished with the simpler electrical drives.

It is really surprising what can be done with our simplest and most reliable type—the squirrel cage induction motor. The primary purpose of this article is to summarize its characteristics and to make sure we do not overlook its possibilities.

A few years ago the electrical manufacturers' catalog covering squirrel cage induction motors was a simple listing of motor ratings and speeds, and with practically no electrical or mechanical modifications available. The motor was likely to have a starting torque not much more than full load torque, high starting current, and it was assumed that this motor was suitable only for applications where the motor was started infrequently and ran continuously in one direction at a nearly constant load.

Types of Squirrel Cage Motors

Today, so many different types of squirrel cage motors are available that the question is usually not whether a suitable motor for an application is available but which one of several available ones should be used. For instance, NEMA has recognized and defined six classes of motor in regard to the speed torque curve of the motor alone. When all of these speed torque characteristics are combined with such features as the time and temperature ratings, types of enclosures and other special mechanical features, there are literally thousands of combinations that can be specified. Most manufacturers list motors on the basis of the various speed torque characteristics standardized by NEMA, and in addition list motors that have been specially designed for such applications as elevators, hoists, presses, and extractors to mention only a few. Yet with all of these hundreds of combinations the basic design of the motor is the same in regard to its electrical characteristics, and it is the most widely used motor that we have today.

As we all know, a squirrel cage induction motor is essentially a constant speed motor. However, this motor must be started and stopped, and in many cases reversed. The conditions in the motor while starting, stopping and reversing are entirely different from those when it is running at its normal speed, and the combination of these conditions is what is generally called the duty cycle.

Once the duty cycle that the motor must meet has been determined, it is possible to determine the relative motor losses for the various portions of the cycle and also to control these losses by proper motor design to obtain the most efficient overall characteristics. How the motor characteristics can be varied to meet the different duty cycles to the best advantage, will now be described.

The most common way to vary the speed torque characteristic of an induction motor is by varying the rotor resistance. To use this means to the greatest advantage a wound rotor induction motor is quite frequently used and different characteristics obtained by varying an external resistor connected in the rotor circuit. Typical speed torque curves of a wound rotor induction motor with varying amounts of secondary resistance are shown in Fig. 1, and the number of curves that can be obtained is limited only by

The electric motor is so common and so reliable a piece of electrical apparatus that most of us take it for granted. A motor, properly applied will run practically without attention and under the most severe conditions for months and even years. To apply a motor to a given load, however, requires knowledge, not only of the characteristics of the motor but also of the load. Many articles have been written and published giving information in regard to the application of electric motors but few that we have seen give as much information in this respect as does this article by Messrs Stein and Caldwell. It describes in detail the various types of induction motors, considers their construction in terms of their characteristics and adaptability to certain types of service. It tells you what you need to know about torque and speed and heating, what happens during the starting period, how high inertia loads affect the motor, etc. Of equal importance, it tells you what different types and classes of motors are available. In short, this is a bang-up good article on the general application of motors.

R FOR THE APPLICATION

By J. M. Stein and G. A. Caldwell
Motor Engineering Dept. Industry Engineering Dept.
Westinghouse Electric Corporation

the number of resistance points available.

For many applications, a single characteristic is sufficient, and it is not necessary to vary the rotor resistance. In this case rather than winding the rotor with phase windings it is much more economical to build the squirrel cage winding which consists of straight bars distributed around the rotor periphery and connected on the two ends with resistance rings. This rotor is almost a solid mass of metal and is practically indestructible.

The most common of the squirrel cage induction motors is the general purpose motor of NEMA Class A having a speed torque characteristic similar to curve No. 1 of Fig. 1. On the basis of rated torque, the starting torque is approximately 150 per cent and the maximum torque approximately 200 per cent. The slip at full load is less than 5 per cent and the locked current is approximately 65 per cent. The relative shape of the curve is shown in Fig. 2. This type of motor has a high running efficiency and is applicable to continuous loads where the motor is not subject to frequent starts on a system of high inertia.

The squirrel cage winding of the general purpose induction motor is generally built of copper bars and resistance rings or as a die casting of aluminum. When a torque characteristic such as shown in Fig. 1, curves No. 2 and No. 3, is desired, the rotor winding is constructed of brass or bronze or other high resistance alloys, or cast of various aluminum alloys. The characteristics are shown in Fig. 3. These rotors are used in motors for hoist, shear, and press applications. The types considered standard usually fall in three categories. (1) The punch press motor with 5-8 per cent slip. (2) The punch press motor with 8-13 per cent slip,

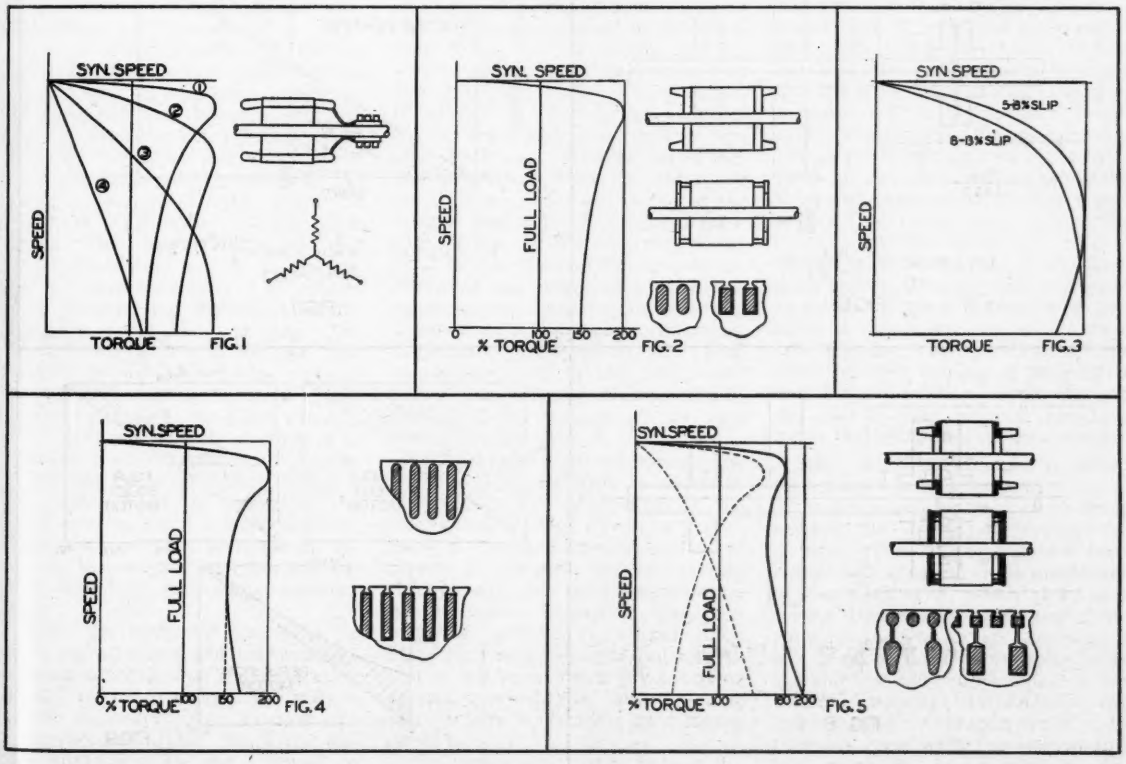
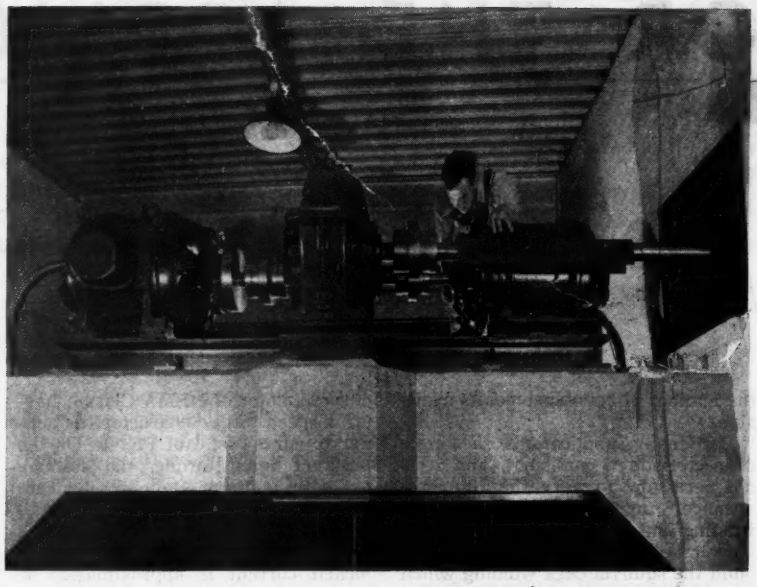


Fig. 1. Speed torque characteristic of general purpose induction motor with squirrel-cage winding of straight copper bars connected to resistance rings. Curve 1. Curves 2 and 3 are torque characteristics resulting with rotor windings of brass or bronze or other high resistant alloys. Fig. 2. Speed-torque characteristic of general purpose induction motor. Fig. 3. Speed-torque characteristic of general purpose induction motor with special rotor for punch press or hoist operation. Fig. 4. Speed-torque characteristic of induction motor with rotor slotted to accommodate extra deep bars. Fig. 5. Speed-torque characteristic of induction motor with double deck rotor. Constructional features of this motor are shown at right.

and (3) the Hoist motor usually having slips about the same as (2) but with an intermittant time temperature rating using a smaller frame size than the comparable general purpose motor of the same horsepower rating. These motors are included in NEMA Class D. The maximum torque of the higher slip machines is usually developed at zero speed and is 250 to 300 per cent of rated torque. Because of the higher slip and lower efficiency this characteristic is not usually used for motors running continuously at full load.



Motors for Low Starting Torques

There are motors developed especially for low starting current requirements which must rely on means other than secondary resistance to obtain high torque per unit current. The most popular motor in this class is the Class I motor (NEMA Class B) which uses a rotor construction which incorporates deeper bars than the general purpose motor. The increased depth of bar causes the current to crowd toward the top; this crowding increasing with rotor frequency. Since the rotor frequency is higher under locked conditions than under running conditions the apparent resistance of the rotor is higher resulting in increased starting torque per unit current. Hence we have characteristics in the running region approaching those of the general purpose motor and approaching those of the high slip motor under locked con-

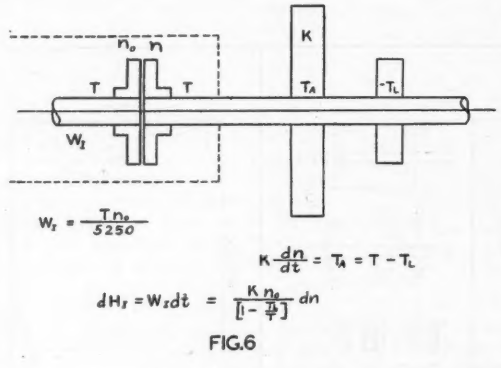


FIG.6

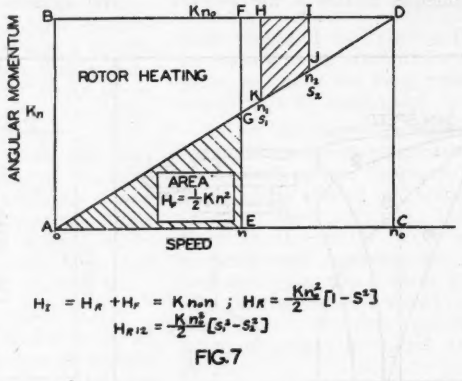


FIG.7

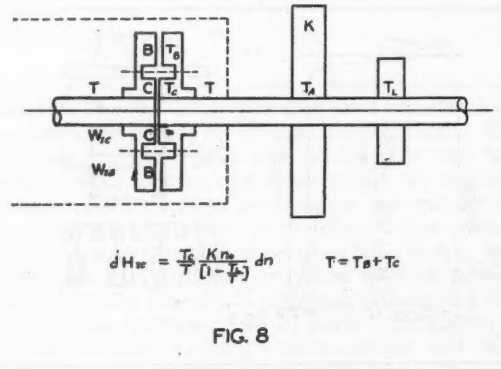


FIG. 8

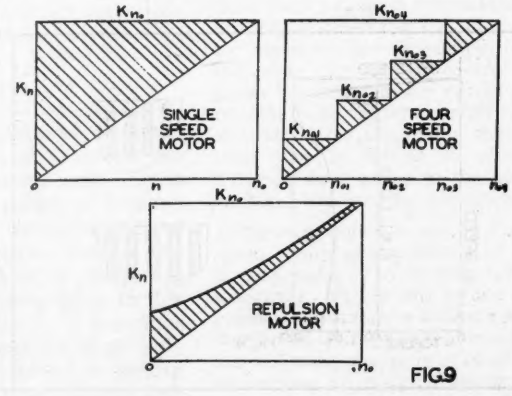


FIG.9

Fig. 6. Mechanical analysis to illustrate heating of the rotor. Fig. 7. Flywheel momentum is plotted against speed to show heating and other energy components relatively. Fig. 8. Mechanical analysis of double deck motor to illustrate heating of the rotor. Fig. 9. Flywheel momentum is plotted against speed to show heating and other energy components relatively for single speed, four speed and repulsion motor.

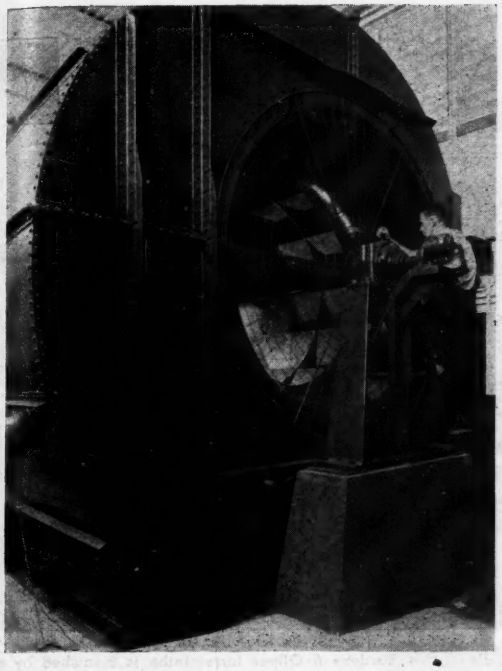


Fig. 10. Excess thermal capacity is provided in the Westinghouse induction motor shown on the opposite page to keep the temperature rise within acceptable limits during acceleration of a high inertia fan load

ditions. The speed torque characteristics of this type of motor are shown in Fig. 4. The maximum and starting torques are approximately the same for the general purpose motor, but the locked current is reduced considerably.

The crowding of current to the top of the bar may become more effective if the top of the bar has a higher resistance and may be increased further by allowing a flux leakage path between the upper and lower parts. This is exactly what is done in the Class 2 motor (NEMA Class C) which is built with a double deck rotor. The characteristic of this motor are shown in Fig. 5. The top bar and ring are generally of smaller cross section and higher resistivity than the lower bar and ring. The Class 2 motor has a 200 per cent starting torque, 18 per cent pull-out torque, and starting currents of the same magnitude as the Class 1 motor. With reduced voltage starting it is possible to obtain a further reduction in starting current without risking a low torque. Let us emphasize the point that the Class 2 motor was designed primarily as a means of obtaining low starting currents and not as a motor for high torque applications.

From the foregoing description of motor construction and performance, we may conclude that the application of the motors to continuous loads is chiefly dependent upon running efficiency considerations. While the torque characteristics are changed to produce the necessary starting torque with reduced starting currents, no particular consideration is given to the losses in the motor under starting conditions.

When an induction motor is connected to a load of high moment of inertia and with frequent starting and stopping, we must consider the amount of heat generated in the various members as the motor changes in speed. The rate of acceleration of the load is proportional to the available torque of the motor and inversely proportional to moment of inertia of the system. This results in a time of acceleration which is shorter the higher the available torque. From our consideration of torque for various rotor resistance, we see that the power dissipated in the rotor is higher for the higher resistance. Since the total heating in the rotor is a product of the time of acceleration and the average loss in the rotor, we find that the rotor heating is independent of the rotor resistance. It actually is equal to the total energy absorbed in the accelerated mass. This indicates an overall efficiency of the rotor of 50 per cent during acceleration.

The heating of the rotor when the whole system is subject to a change in speed is well illustrated by the mechanical analogy shown in Fig. 6. Here a constant speed source of power is coupled to the system through a clutch with speed torque characteristics identical with the motor in question. The output clutch plate itself may be considered equivalent to the rotor which is rotating at speed n due to friction with the other plate which is rotating at constant speed n_o.

The torque required to change the speed of the flywheel is proportional to its moment of inertia and its acceleration. The input to the clutch is proportional to the product of its input speed n_o and the torque T. The torque available for acceleration is the difference of the motor torque and the load torque i.e. $(T-T_L)$. This results in the heating energy in the rotor (clutch) being independent of the torque if the load torque is small. Figure 7 shows the angular momentum K_n plotted against n. This is used so that the heating and other energy components are represented by areas under and over the curves. The sloped line AD is K_n and the horizontal line is Kn_o.

With a negligible load torque, we see that the energy input in accelerating from O to n is given by K_n x n and is represented by the area ABFE. The part of this absorbed by the rotating mass is obviously $\frac{1}{2}$ K_n^2 represented by the AEG. Hence the remaining area ABFG represents the heating in the rotor due to the acceleration from speed O to speed n. By the same reasoning the heating in the rotor in a speed change from n1 to n2 is given by the area HIJK which may be shown is proportional to the difference of the square of the slips. This loss due to slipping is much the same as exists in the clutch.

Heating with Changes in Speed

The heating of the stator bears the same ratio to the heating of the rotor as does its resistance to the resistance of the rotor. From this we see that for the minimum total heating of the motor it is desirable to have a small ratio of stator to rotor resistance. Since there is a limit to how low the stator resistance can be made, low stator heating is accomplished by a motor with a higher rotor resistance. The rotor heating on acceleration as previously pointed out is equal to the energy absorbed by the moving mass and independent of rotor resistance. This takes place during the change of motor speed from zero to full speed and a change of slip from unity to zero. When a motor is plugged to a stop the speed changes from full speed to zero speed and the slip from two to unity. This results in a rotor having a rotor heating of three times that for acceleration. From this we see that a plug reversal has four times the heating of an acceleration.

Since all these changes in speed take place over relatively short spaces of time, we may without much error neglect the dissipation during the changes. This means that the heat results in increasing the temperature of the member in which it is generated. Hence the temperature of the rotor at the end of an acceleration will be proportional to the rotor heating and inversely proportional to its thermal capacity. Incidentally, the losses during acceleration are 30 to 40 times as great while running at full load since the losses vary as the square of the line current. From this we see that although the motor may be perfectly capable of dissipating the heat generated when considered over the whole duty cycle, it is possible for the rotor winding to overheat on

a single acceleration. This is more true on the double deck motor than for any other.

The double deck motor may be considered without much error as being equivalent to two separate motors. The top part will be equivalent to a rotor with torque characteristics shown on curve 3 of Fig. 1, while the bottom part will have characteristics as shown on curve 1 of Fig. 1. When we consider two motors connected to the same inertia load it is necessary that the total rotor heating be the same as if one motor is connected to the same load. However, the division of heating between the two rotors will be proportional to their respective contributions to the torque. Since the upper winding of the double deck rotor contributes most of the torque during acceleration and has a much smaller thermal capacity, one can well see what temperatures it may attain when the motor is accelerating a high inertia load. Even if excessive temperatures are not reached, the temperature differentials result in unequal expansion and contraction which may finally cause a mechanical failure in the rotor bars. It is for these reasons that Class 2 motors should not be used on applications with frequent starting and stopping.

The mechanical analogy to the double deck motor is shown in Figure 8 where the top deck is represented by a small clutch (C) with high torque transmission and the bottom deck by a large clutch (B) with small transmission. Here we see that the heating is highest in the small clutch transmitting the most torque. The folly can be seen in using such a transmission scheme for accelerating a high inertia load.

One way to reduce excessive heating in the rotor of a squirrel cage induction motor when accelerating an extremely high inertia load is to make use of a multi-speed motor. These multi-speed motors have 2, 3, or 4 running speeds depending upon the design of winding. Any primary winding can be arranged for a regrouping connection which gives two fixed speeds, one one-half the other. It is also possible to wind two separate windings on a stator and by regrouping this second winding to get a total of four speeds. By going through the proper sequence of operation by starting on the low speed winding and successively transferring from one winding to the other up to the maximum speed, a motor can accelerate a given inertia with only 25 per cent of the rotor loss if the motor load were accelerated with a single speed motor. The comparison of heating is shown in Fig. 9, and it is obvious that the higher the number of speeds the lower the rotor losses, and with an infinite number of speeds the rotor loss would be zero. This condition is approached with a variable frequency drive where a squirrel cage motor is controlled in speed by varying the frequency applied to the stator. This represents a very special form of control, and though it has been used in many instances is not particularly applicable to machinery electrification and will not be described further here.

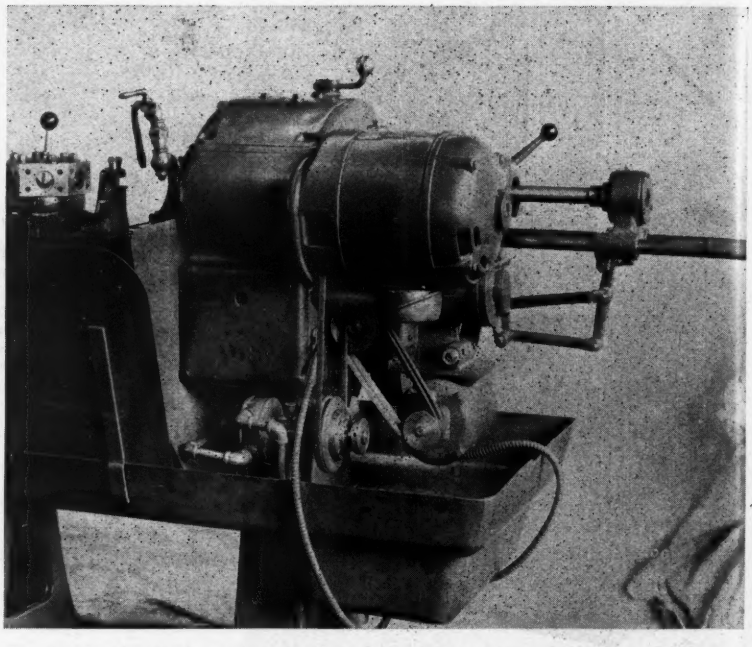


Fig. 11. Power for the spindle of this Bardens & Oliver turret lathe is furnished by a Westinghouse reversing, two-speed induction motor

Multi-Speed Motors

The multi-speed motor is also very effectively used in decelerating a load by transferring from the high speed to the low speed windings in sequence and is a much more efficient and definite way of slowing down a squirrel cage motor than by plugging.

While the use of a multi-speed motor materially reduces the losses during acceleration, the motor is practical for this purpose only when the external inertia is large compared to the inertia of the rotor itself. This is due to the fact that the multi-speed motor itself is larger than a single speed motor and therefore has considerably more inertia in its rotor than a single speed machine. Also the same results can be obtained by the use of a wound rotor induction motor with external secondary resistors. However, many applications demand slow-downs at the end of the cycle, and here the multi-speed squirrel cage motor is very effectively used.

The use of a-c commutator motors is somewhat limited because of poor commutation but on single phase supply lines the repulsion type of motor is often used for accelerating high inertia loads. With this type of motor as with d-c motors the heating in the rotor is small on acceleration and presents similar characteristics to a variable frequency system. These losses are illustrated in Fig. 9.

With this background on the fundamental characteristics of squirrel cage induction motors, let us turn our attention to some definite applications.

Definite Applications

For the largest group of applications as represented by fans, pumps, compressors, conveyors, etc., which are started and stopped infrequently and have low inertia loads so that the motor can accelerate in a few seconds, the conventional general purpose motor can be used. If the motor is installed at a location where there is limitation on the starting current the Class 1 motor can be used, or if the current is still in excess of what can be permitted then reduced voltage starting is employed. On those applications where reduced voltage starting does not give sufficient torque to start the load with either general purpose or Class 1 motors, the Class 2 motor with its high inherent torque along with reduced starting current supplied with combination with reduced voltage starting will solve the problem.

On those applications such as some conveyors and compressors sometimes requiring starting torques of at least twice full load motor torque, the Class 2 motor must be used with full voltage starting.

One type of drive in this general classification which sometimes requires special consideration is the drive for large fans. These drives, once they are accelerated, run continuously at full load, and therefore it is desirable to have the best possible efficiency and power factor. However, some of the fans have ex-

(Continued on page 130)

Trends in Steam Boiler Designs of Our Friends and Enemies

In Great Britain, the most popular boiler capacities in the principal plants range from 200,000 to 300,000 lb per hr. One boiler is rated at 550,000 lb per hr. Two boilers per turbo-generator is preferred practice. Maximum pressure, 1900 psi, final temperatures 930 to 960 F. Regenerative feedwater heating widely applied. Boilers designed for radiant heat absorption. Trend is toward use of bent tubes.[1]

In Germany, trend is toward radiant boilers, natural circulation, bent tubes, elimination of sectional headers. Capacities range up to 440,000 lb per hr. Steam pressures of 1750 psi at 925 F found to be reliable.[2]

IN 1914, ELECTRICITY was supplied in Great Britain from 459 generating stations; the cycles ranging from 25 to 40 and 50. In 1939 an electrical output nine times greater than that of 1914 was supplied from 167 generating stations, at a common frequency of 50. The change was largely the result of the Electricity (Supply) Bill passed by Parliament in 1926, when a measure of order was introduced into the business of electricity generation in Great Britain. Of the then-existing power stations, some were prominent by virtue of their high operating efficiency and low generating costs, and the Central Electricity Board, created by the Act, was empowered to select, control and interconnect such stations. Thus was formed a nucleus system on which was developed a nationally coordinate electricity supply. The now well-known "Grid" came into existence, and its standards have exerted a major influence on the subsequent design of British power stations.

By concentrating the electrical output into relatively few stations, it has been possible to employ large and efficient turbo-generators, and the increase in turbo-generator size has necessitated a corresponding increase in boiler capacity. This tendency has been accentuated by the desire to install the minimum number of boilers per generating set. Turbine heat consumption has been reduced by successive rises in steam pressure and temperature, and these conditions, in turn, have been satisfactorily met by boiler designers.

Boiler Development

Twenty years ago, boilers having a capacity of 100,000 lb. per hr were about the maximum installed in British power stations, but now at least one boiler is in service with a capacity of 550,000 lb per hr. The pre-1939 tendency was to dispense with boilers below the 100,000 lb per hr class, and even in the year 1937 to 1938 there was a reduction of six per cent in their numbers. According to recently published information the greatest increase in numbers is in the 200,000 lb per hr and higher class. There are now 39 boilers rated at 200,000 lb to 250,000 lb per hr, producing a total of 8,696 x 10^6 lb per hr; and 30 boilers rated at 251,000 to 300,000 lb per hr, producing a total of 8.06 x 10^6 lb per hr. The limiting factors are the size of the turbo-set and the number of boilers allowed per set. Most British

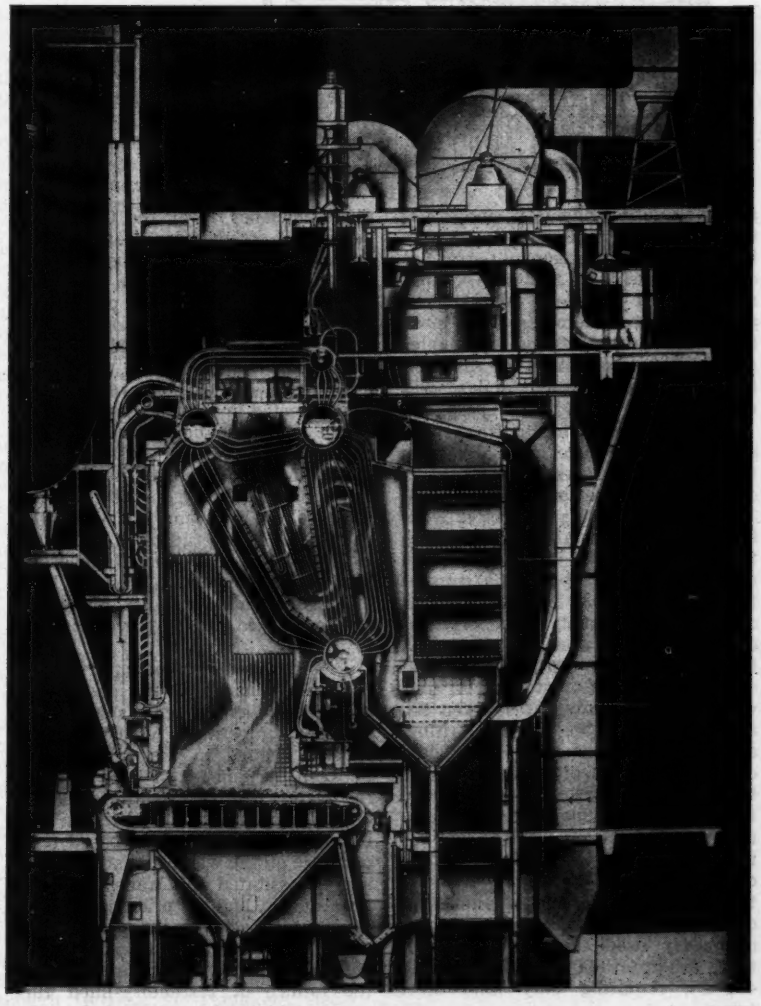


Fig. 1. Bent-tube boiler built in Great Britain for an output of 200,000 lb per hr; 650 psi, 875 F steam

[1]An article prepared for exclusive use in Power Plant Engineering by Sydney D. Scorer, AMIME.

[2]Information gleaned from an article in the March, 1045, issue of Engineering and Boiler House Review, published by Engineering Review Publishing Co., Ltd., of London, England.

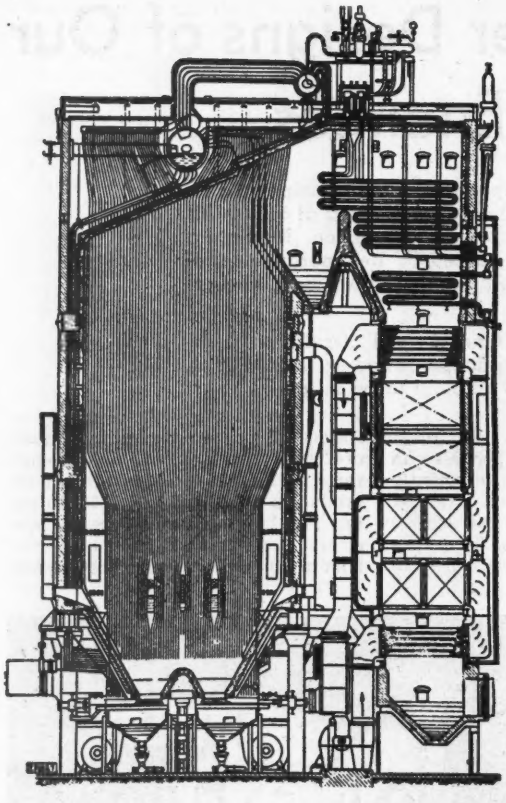


Fig. 2. Radiant type boiler of German design with furnace for pulverized lignite corner firing; 440,000 lb per hr capacity 1800 psi, 932 F steam with reheater

power-station engineers prefer to use two boilers per turbo-generator, each boiler having an economic capacity of 50 per cent of the total output required, but capable of supplying 65 per cent of requirements at its maximum continuous rating. Until boiler availability equals that of turbines, it is probable that this standard will remain.

Steam pressures in British power-station practice have gradually risen to a maximum of about 1,900 psi; a common pressure after 1920 being 350 psi. After 1930 a number of well-known stations installed boiler plants for 600 to 650 psi. This represents average practice up to the present time. During 1936 to 1938 the increase in the capacity of boilers generating steam at over 550 psi was no less than 71 per cent, and in 1944 some 14 x 10^6 lb of steam per hour were being generated at between 600 and 700 psi. At the time of writing, a few power stations are constructed or are in process of construction for steam pressures ranging from 1,200 to 1,900 psi. The final steam temperature in these stations varies from 930 to 960 F deg (499 to 516 C). Wartime conditions have necessarily tended to restrict the erection of plants requiring alloy steels, so that the most commonly used superheat temperatures are from 800 to 850 F (427 to 454 C), requiring only mild steel tubes.

In British practice the most widely applied method of increasing power-plant efficiency is by the use of regenerative feedwater heating. The feedwater temperature thus obtained is at a present maximum of about 400 F (204 C) in the 1,400 psi boilers, while in the more common 600 psi designs it is from 300 to 350 F. (149 to 177 C). Large turbine economies have resulted, but boiler design has been affected in that the flue-gas temperature cannot be reduced by the economizer to a figure consistent with maximum efficiency. Air heating has in consequence been generally adopted to solve the problem, but when the heated air temperature is likely to exceed 350 F (177 C), it cannot be used with mechanical stokers. This, in some installations, has influenced the decision to employ pulverized fuel firing.

Heat Distribution

A consequence of the steady increase in boiler capacity, steam pressure and temperature has been a continuous change in the relationships between the amount of heat required for water heating, steam formation and steam superheating within the boiler. Moreover, the increased temperature on the water and steam sides has necessitated the transmission of heat at the highest practicable temperature to achieve the greatest effect. The advantages of radiant-heat transmission were recognized when the failure of refractory-lined furnaces at high heat ratings led to the adoption of water walls. Thus the heating surface in the neighborhood of the furnace zone has acquired much importance, and in power station practice it invariably consists of water tubes; bare, block-covered or finned. The superheater surface, also, has been massed nearer to the furnace, so that the requisite temperature head can be made available, and, in the radiation-convection type, part of it forms a proportion of the furnace radiant-heat receiving furnace.

A trend of preference is towards the use of bent-tube boilers, and Fig. 1 shows an example of this type developed by Mitchell Engineering Ltd. of London and Peterborough. This boiler was designed for an output of 200,000 lb per hr at a steam pressure of 650 psi and a final steam temperature of 875 F (468 C). The front bank tubes are widely pitched to form a slag screen, and are also staggered to facilitate radiant-heat absorption. A steam receiver is situated above the rear steam drum and is connected to both drums. The furnace is cooled by bare tubes; refractory or metal blocks being fitted over the tubes where necessary. The superheater is of the convection type, but a combined radiant-heat and convection superheater is provided when warranted by the working conditions. A special feature has been made of boiler availability.

Recent Trends in German Boiler Design

Many of the most advanced ideas on the construction of modern boilers originated in Germany and it is apparent that the number of types manufactured in that country became so great that for economy purposes a standardization of boiler types was adopted shortly before the war. Fuel conditions, however, still compel the use of a considerable number of types distinguished chiefly by differences in water-cooled furnace designs. The trend has been toward a radiant heat boiler particularly suitable for the fuel available, the characteristics of which have been and still are giving operating troubles.

Radiant boilers of the natural circulation type are trending in design toward the use of bent tubes entirely, with the elimination of sectional headers. Another of the newer features of basic German-built radiant boilers is the employment of a separator drum which is not subjected to high furnace temperature thus permitting it to carry a low water level. To do this, however, requires ample steam and water circulator areas between separator drum and upper boiler drum, a problem which, apparently, has not been completely solved, judging from recent reports, though the use of throttling devices in the steam circulators has proved effective in some cases.

In the development of radiant boilers, economizer sections have been incorporated which raise the temper-

ature of the water to the evaporative point thus reserving the radiant sections of the boiler for steaming purposes exclusively. Reports indicate that this method of operation has greatly aided the maintenance of water level, particularly in high pressure boilers.

Uniform Water Distribution

One outstanding accomplishment reported is the achievement of uniform water distribution to the individual evaporative tubes, every circuit having its own independent water supply by downcomers from the top drum or separator drum. Latest designs for operation at highest pressures employ no heated downcomers, which, it is reported, results in stable natural circulation.

In the latest type of German boilers for operation at the highest pressures heated downcomers are completely eliminated, and this results in entirely stable natural circulation. As a matter of fact, it is reported that in many German boilers of this type the great length of vertical risers has caused excessively high rates of circulation, so that it had to be throttled by the installation of orifices in the circuit.

LaMont boilers have been built in Germany for capacities as large as 220,000 lb per hour. The looped arrangement of the water wall tubing employed in German LaMont designs was found to be not sufficiently reliable where the tube length is great; this being due to the fact that evaporation occurs in the descending legs of the loop as well as in the upper part of the ascending leg. This steam creates a lift which counteracts the pressure of the circulating pump. It is further reported that in the case of slanting tubes a separation of water and steam may occur in the bend of the loop which may result in the creation of stationary steam pockets at that point. The ensuing dissociation of the steam may then lead to very rapid local corrosion.

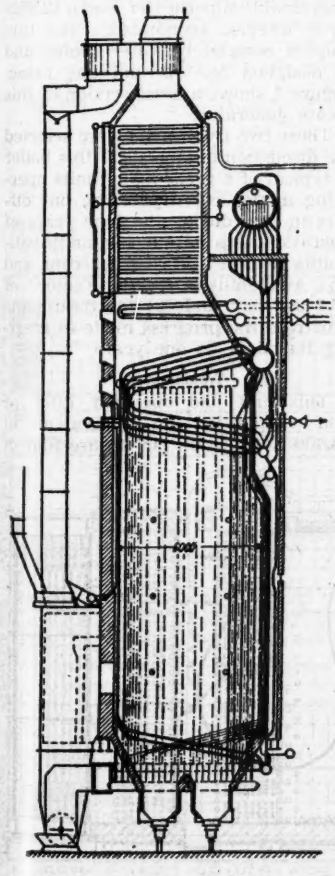


Fig. 3. German boiler (Schmidt-Hartman) designed for use of pulverized lignite; capacity 120,000 lb per hr, 1800 psi, 942 F

Similarity of Design

The various German boiler types of recent design generally resemble each other regarding outer contour, dimensions and disposition of the heating surfaces. Superheaters and economizers employed in the various designs, including forced-circulation types, are completely identical, and the evaporation parts differ only with respect to tube diameter and whether or not boiler drums are employed, these latter, of course, being absent in the once-through type. This similarity of design is chiefly due to the combustion conditions which determine size and shape of furnace, and, with it, boiler dimensions proper. Forced-circulation boilers weigh about 4 per cent on the average, and 7 per cent less, at most, than the natural circulation type. If the boiler structure is included, forced circulation boilers at the most may weigh 10 per cent less than units of the natural circulation type. This may be narrowed down by the use of smaller tubes for natural circulation boilers.

German designers are of the opinion that present practice will, in the main, continue for some years to come. Further progress in the knowledge of boiler circulation and flow distribution and its more scientific application to boiler design appears, however, to be a matter of some urgency; increased attention should also be paid to feedwater treatment. Further development of combustion equipment is recognized as one of the most important tasks.

German experience with steam condition of 1750 psi and 925 F and high extraction pressures, as well as, interstage reheating has proved conditions to be as reliable in operation as somewhat lower temperatures and pressures. Even temperatures of 968 to 986 F are contemplated as a means of dispensing with reheating and still not exceeding 13 per cent moisture in the turbine exhaust steam. Such high temperatures, however, will require high heat-resistant steels which are not immediately available although German steel makers claim they have succeeded in providing suitable substitute materials.

Lubrication Department Organization*

By C. A. Bailey

Gary Steel Works
Carnegie-Illinois Steel Corp.

WHEN SETTING up an organization to handle the maintenance and operation of mechanical equipment, it is advisable to make special provision for lubrication. Thus, one unit of the maintenance department will be responsible for lubrication. Under such a set-up, lubrication assumes its rightful importance and does not become an item to be taken care of only after all other mechanical work has been completed or as an odd job to be done in spare time.

When a lubrication department is being established in a new plant, the problems are quite different from those involved in the installation of a new system in an old plant. In the new plant the machinery is modern and designed for easy, adequate lubrication at all times. The lubrication department should then be staffed with craftsmen trained to maintain and service all the equipment in the plant. The size of the department and its organization will depend upon plant conditions equipment.

Whenever possible, the lubrication engineer should work with those in charge of layout, operation and maintenance so that most effective lubrication equipment may be installed when the machinery is built and the whole coordinated to assure most efficient and economical lubrication at all times.

In a well organized lubrication department, the lubrication engineer has the following duties, the list being, of course, subject to modification according to the size and departmental set-up of the company or plant.

1. Ordering of lubricants.
2. Storage and dispensing.
3. Application.
4. Reclamation.
5. Installation of lubricating equipment.
6. Maintenance of lubricating equipment.
7. Recommendations as to solution of lubrication problems and equipment for new machinery, cooperating with designers when necessary.

The number of lubricants should be limited to as few as possible, yet a sufficient variety of kinds and types must be provided to permit proper lubrication of the equipment in use. A survey of needs, listing each piece of equipment and the types of lubricant required to service it, will serve as a basis for ordering lubricants. Preparation and intelligent use of charts, thorough training of the crew, and adequate supervision is essential.

*Condensation of a paper presented before Chicago meeting of Association of Iron and Steel Engineers, April 3, 1945.

Chemical De-Scaling of a Modern Steam Generator

By M. E. Brines

Power Division

The Dow Chemical Co., Midland, Mich.

Details of two chemical treatments, a year apart, for cleaning a 2-drum, D-type, 150,000 lb-per-hr, 425-psi, 735 F unit . . . Unit typical of many now operating . . . Treatments illustrate progress in treating technique . . . Single tube experiments, made first, prove value of preliminary data before making actual treatment . . . Treatment A gave average scale removal of 99.3 per cent, treating for 6 hr contact time at 170 F . . . Treatment B gave average scale removal of 99.7 per cent, with slightly different treatment from A, for 6 hr contact time . . . Composition of deposits before treatment, temperatures during treatment, amount of deposit removed, composition of deposits after treatment, shown in tabulations

THE DOW CHEMICAL CO. of Midland, Mich., and one of its subsidiaries, Dowell, Inc., made their first venture into the field of chemical cleaning of large power plant equipment on January 15, 1936. This project was the acid cleaning of a 13,663-sq ft hairpin-tube integral economizer. Since that time the two organizations have worked hand in hand with the research departments in the development of improved treating techniques. A great variety of deposits have been successfully removed from many types of equipment since that time.

The following discussion will be confined to two treatments of a Foster-Wheeler, 2-drum, D-type steam generator designed for a maximum load of 150,000 lb of steam per hour at 425 psi and a final steam temperature of 735 F. This unit is equipped with a 1960-sq ft, 4-loop pendant-type undrainable superheater, and a 12,852-sq ft integral economizer. The furnace is completely water cooled and is designed for oil and gas firing. Figure 1 shows a cross section of this steam generator.

These two treatments were selected for discussion because: (1) this boiler is typical of a great many units operating in this country today, but differs in that during the four years of operation, this unit has had an "Availability Factor" of 98.0 per cent and an "Availability-Capacity Factor" of 87.4 per cent and (2) the treatments illustrate the progress made in treating technique in one year.

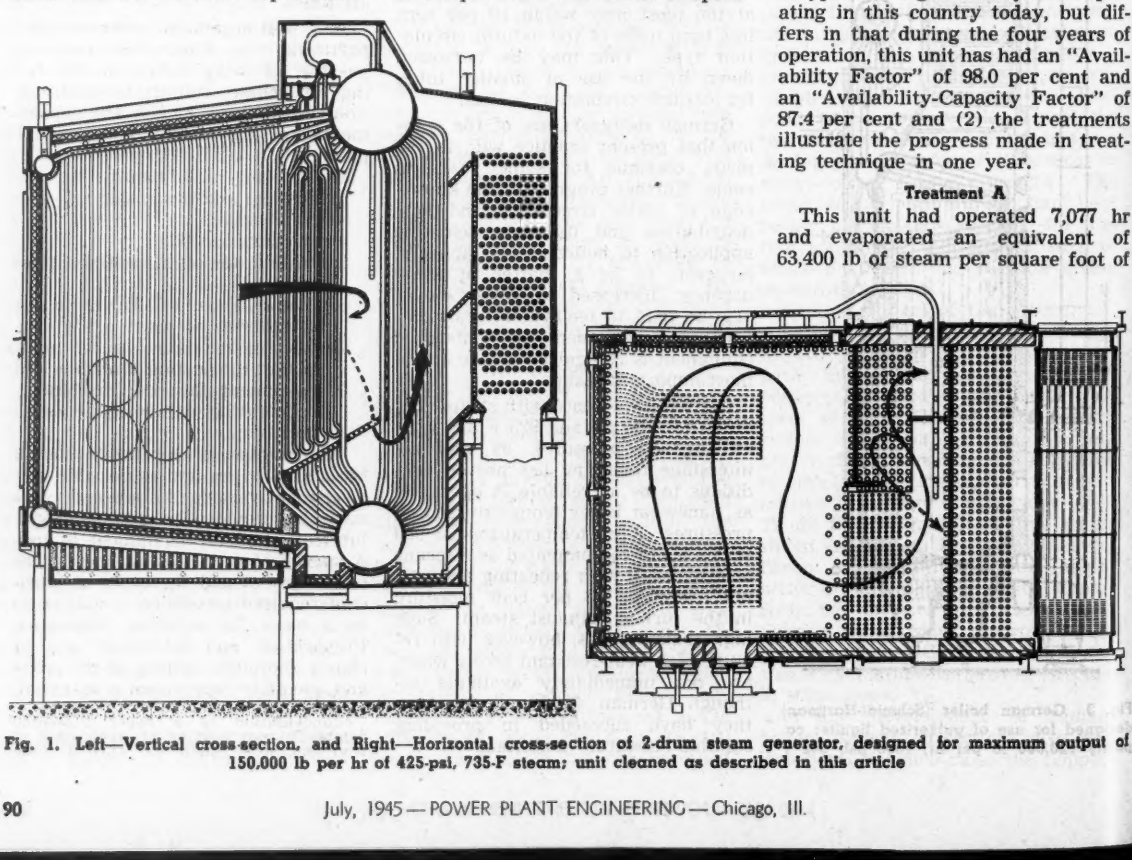


Fig. 1. Left—Vertical cross-section, and Right—Horizontal cross-section of 2-drum steam generator, designed for maximum output of 150,000 lb per hr of 425-psi, 735-F steam; unit cleaned as described in this article

Treatment A

This unit had operated 7,077 hr and evaporated an equivalent of 63,400 lb of steam per square foot of

Table I. Chemical composition of scale before Treatment A

		3" Tubes First Row Generating Section	3" Tubes Third Row Generating Section	2½" Tubes First Row Generating Section	West Water Wall 3¼" Tube
Hydroxy Apatite	$Ca_{10}(OH)_2(PO_4)_6$	45%	45%	50%	45%
Serpentine	$Mg_3Si_2O_7 \cdot 2H_2O$	10%	10%	20%	15%
Vermiculite	$(Mg, Fe)_3(Al, Si)_4O_{10}(OH)_2 \cdot 4H_2O$	20%	20%	20%	15%
Analcite	$NaAl\ Si_2O_6 \cdot H_2O$	10%	20%		15%
Hematite	Fe_2O_3	15%	5%	10%	10%

heating surface since the last cleaning. Pressure drop determinations across the economizer revealed that it was free of deposits, making it unnecessary to treat this portion of the unit. Samples of scale were turbined from representative tubes selected at strategic points throughout the unit. Table I gives the X-ray analysis of the deposits found in these tubes.

Single Tube Experiments

These analyses revealed a type of scale that was unusual for this plant. Due to this unusual type of scale, it was decided to conduct single tube experiments for the purpose of collecting the following data:

(1) Determination of the optimum acid concentration for the complete treatment;
(2) Comparison of weights of turbinings before and after experimental treatments to determine the expected success of the complete treatment;
(3) X-ray examination of the original scale and that remaining after treatment in order to select the proper auxiliary chemicals;
(4) Determination of silicate removal agent remaining in spent acid; and
(5) Determination of required time and temperature of treatment.

Two boiler tubes were closed at top and bottom with rubber stoppers fitted with pipe nipples. A surge tank equipped with a heating coil was connected to a gear pump, which circulated the treating solution through the two tubes in series and overflowed back to the surge tank. Saran tubing was used throughout the experiments for all circulating lines. Four sets of tubes were treated with varying conditions and treating solutions. Results averaged above 94 per cent removal of scale. (Determined by weights of samples turbined from comparable tubes before treatment and treated tubes after.)

From data collected in these experiments it was decided to treat the boiler with inhibited hydrochloric acid containing special addition agents appropriate to this particular scale. Data indicated that 6 hr treating time at a temperature of 170 F. would give a successful treatment.

Control of Treatment Temperatures

Prior to the treatment the boiler and setting were brought up to a temperature of approximately 200 F. The superheater outlet and drain valves were closed and the economizer inlet valve was closed. The boiler was then drained leaving the economizer and superheater full of water and shut off. The top of the boiler was vented outside and the treating solution was pumped into the boiler through the blowdown connections at a temperature controlled between 170 and 175 F. Three hours and forty minutes were required to pump 9700 gal of inhibited acid into the boiler, which filled it within 6 in. of the top of the steam drum.

Table II is a record of the solution temperatures during treatment at different locations in the unit. The solution was allowed to stand in the unit for 6 hrs and then drained. The boiler was then filled with hot water and drained. This washing process was repeated twice to insure thorough washing of the unit.

Results of Treatment A

Following the draining of the final wash water, the drums were opened

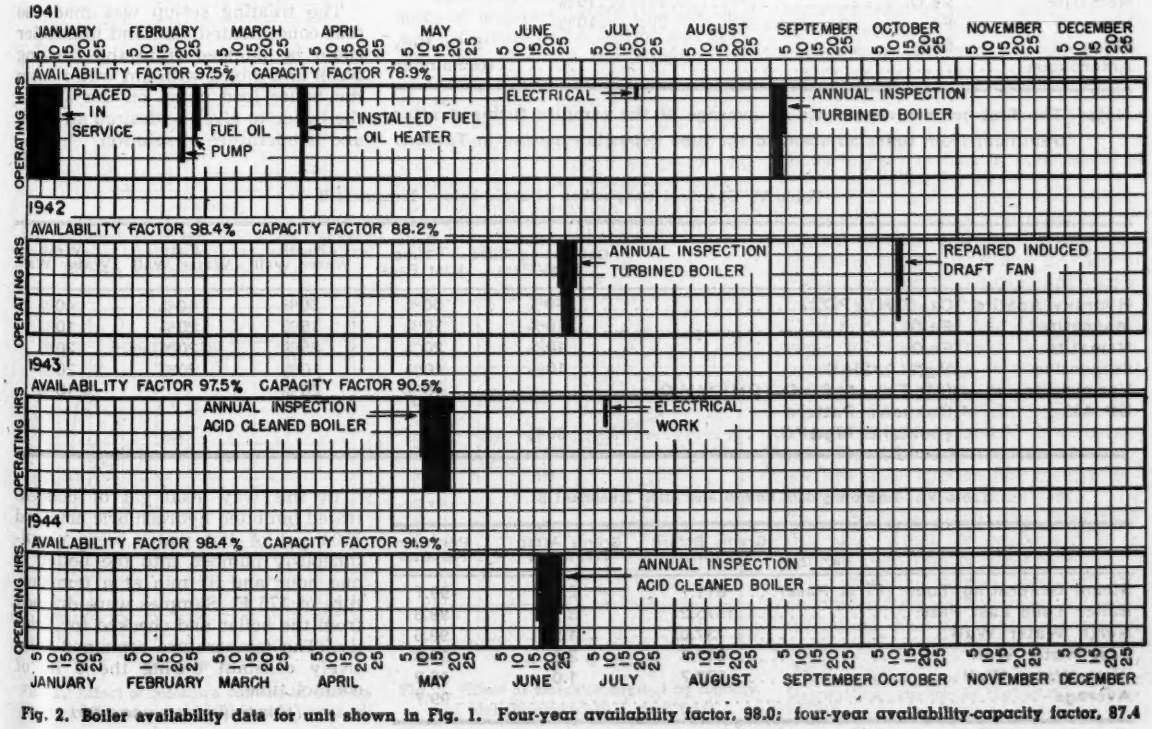

1941
JANUARY FEBRUARY MARCH APRIL MAY JUNE JULY AUGUST SEPTEMBER OCTOBER NOVEMBER DECEMBER
AVAILABILITY FACTOR 97.5% CAPACITY FACTOR 78.9%
PLACED IN SERVICE
FUEL OIL PUMP
INSTALLED FUEL OIL HEATER
ELECTRICAL
ANNUAL INSPECTION TURBINED BOILER
OPERATING HRS
1942
AVAILABILITY FACTOR 98.4% CAPACITY FACTOR 88.2%
ANNUAL INSPECTION TURBINED BOILER
REPAIRED INDUCED DRAFT FAN
OPERATING HRS
1943
AVAILABILITY FACTOR 97.5% CAPACITY FACTOR 90.5%
ANNUAL INSPECTION ACID CLEANED BOILER
ELECTRICAL WORK
OPERATING HRS
1944
AVAILABILITY FACTOR 98.4% CAPACITY FACTOR 91.9%
ANNUAL INSPECTION ACID CLEANED BOILER
OPERATING HRS.
JANUARY FEBRUARY MARCH APRIL MAY JUNE JULY AUGUST SEPTEMBER OCTOBER NOVEMBER DECEMBER

Fig. 2. Boiler availability data for unit shown in Fig. 1. Four-year availability factor, 98.0; four-year availability-capacity factor, 87.4

Table II. Temperature log during Treatment A, temperatures in degrees F

Time	Top West Water Wall Header	Bottom West W. W. Header	Bottom North W. W. Header	Steam Drum
Initial	178	187	149	
1 Hour	169	174	140	
2 Hour	156	167	153	180
3 Hour	162	169	153	
4 Hour	160	167	153	185
5 Hour	162	165	149	183
6 Hour	160	162	149	
7 Hour	160	162	149	183
8 Hour	160	163	147	
9 Hour	156	160	147	180
Average Temp. of Drained Acid 183-188				
Average Temp. of Incoming Acid 170-173				

Table III. Turbining data before and after acid Treatment A

LOCATION	WEIGHT OF SAMPLE IN GRAMS Average Before Treatment	After Treatment	Per Cent Removal
2nd Row Generating Section	400	4	99.0
2nd Row Generating Section	650	8.5	98.7
2nd Row Generating Section	650	1.2	99.8
2nd Row Generating Section	400	0.8	99.8
West Water Wall	520	3.3	99.4
East Water Wall	520	4.7	99.1
North Water Wall	520	2.7	99.5
Average			99.3

Note: The figures in the first two columns represent the weight of material turbined from adjacent tubes before and after treatment.

Table IV. Average chemical composition of deposits after Treatment A

		Turbined From Tubes	Sludge In Mud Drum
Hydroxy Apatite	$Ca_{10}(OH)_2(PO_4)_6$	18%	
Magnetite	Fe_3O_4	62%	
Hematite	Fe_2O_3	10%	
Iron	Fe	10%	
Silica	SiO_2		5 to 10%
Amorphous			Remainder

Note: The first column represents an average of the samples turbined after treatment from tubes adjacent to the tube deposits reported in Table I.

and some water wall handhole plates removed for an inspection of the unit. No evidence of corrosion was found. All heat exchange surfaces and steam separating equipment were clean and free of scale deposits. Representative tubes were turbined to determine the efficiency of the treatment. The data presented in Table III show that the actual treatment gave a higher percentage of scale removal than the experimental tube treatments.

Table IV shows the average chemical compositions of these deposits turbined from the boiler after treatment. This entire procedure is a classic example of the need of preliminary information before making an actual treatment. Without the data obtained from the single tube experiments, the chances of success would have been extremely remote. However, as these data are compiled, future treatments become a matter of routine.

Treatment B in Same Boiler

This same boiler was again acid treated after 9055 hr of operation, corresponding to 1.03 yr of continuous operation. During this time the amount of 425-psi steam generated was equivalent to 85,700 lb per square foot of heating surface.

Samples were turbined from representative locations of the boiler. Table V shows the X-ray analyses of these samples. Laboratory solubility tests indicated that a successful treatment could be made with inhibited hydrochloric acid, containing an intensifying agent, for .6 hr at 175 F. The intensifying agent is added to increase the solubility of the silica component of the scale.

The treating set-up was made so that concentrated acid and intensifier could be pumped from the treating truck and mixed with hot water from the boiler feed pump on the way to the boiler to give the desired strength and temperature of solution.

Table V. Chemical composition of scale before Treatment B

		Steam Generating Tube First Pass	Boiler Tube Last Pass	North Water Wall	East Water Wall	West Water Wall
Hydroxy Apatite	$Ca_{10}(OH)_2(PO_4)_6$	40%	50%	30%	40%	40%
Magnetite	Fe_3O_4	10%	10%	15%	20%	10%
Hematite	Fe_2O_3	10%	20%	25%	20%	20%
Serpentine	$Mg_3Si_2O_7{\cdot}2H_2O$	10%	10%	10%	20%	20%
Vermiculite	$(Mg,Fe)_3(Al,Si)_4O_{10}(OH)_2{\cdot}4H_2O$		10%	20%		10%
UP 423	Unknown Pattern (Contains Mg&PO_4)	30%				

Table VI. Turbining data before and after Treatment B

	Grams Before Treatment	Grams After Treatment	Per Cent Removal
Steam Generating Tube (First Pass)	811.7	2.1	99.7
Boiler Tube Last Pass	1575.2	3.7	99.8
North Water Wall	737.0	1.9	99.6
East Water Wall	812.3	3.8	99.6
West Water Wall	577.7	1.0	99.9
Average			99.7

In this way 4000 gal of concentrated inhibited hydrochloric acid and 5700 gal of hot water were simultaneously pumped into the boiler in one hour and 37 min at a temperature of 175 F. Samples were drained from the boiler and checked for acidity. The temperature remained relatively constant during the 6 hr of contact time.

(Continued on page 99)

Flow of Coal in Chutes*

War-time practices in the use of coal have presented problems resulting from wet coal such as ratholing and arching in bunkers and stoppages in chutes—Models used to study flow and stoppage problems—Physical properties of lot coal measured to find effects on flow characteristics—Essential features of chute design indicated

By E. F. Wolf and H. L. von Hohenleiten

Engineers, Consolidated Gas Electric Light and Power Co., Baltimore

POWER PLANT operators have been faced for many years with a number of major equipment problems and since some of the more important mechanical difficulties have been overcome, those of a minor nature are now coming to the front. At the same time the constant improvements in the art of boiler design have magnified some of these minor troubles. Getting coal from the bunker to stoker hoppers or to coal-pulverizing mills has been one of these problems.

Heretofore the operator usually has been successful in keeping fairly dry coal flowing through his chutes, or in relieving stoppages due to wet coal by employing air lances and some judicious pounding at points where such stoppages occurred. With the use of one boiler for each turbine generator the prevention of coal stoppage now assumes major importance.

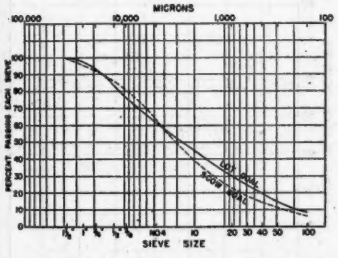


Fig. 1. Sieve analyses of coal (Representative samples taken from scow deliveries and from Riverside storage lot)

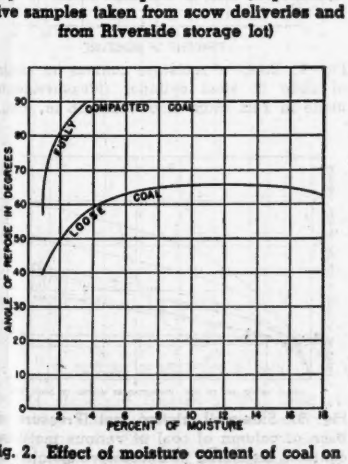


Fig. 2. Effect of moisture content of coal on static angle of repose (Riverside lot coal)

When the Consolidated Gas Electric Light and Power Co. of Baltimore began its expansion program in 1939, it recognized the importance of a trouble-free coal supply and surveyed the field to determine the latest advances in the art of coal-handling and chute design. The chutes installed at the Westport Station extension and at the new Riverside generating station represented the best engineering knowledge available up to that time. Chutes, in general, were kept at as steep an angle as possible, flared chutes were employed, and the angles of the sides of hoppers were maintained at 60 deg or steeper. This has resulted in a chute design, which, in general, has performed well with moderately dry coal.

During the winter and early spring of 1943-1944, government regulations of fuel made it necessary to use large amounts of fuel reserves. This led to extensive use of coal from storage, which by reason of exposure to weather had absorbed large percentages of moisture. With this wet coal a great amount of ratholing and arching took place in the bunkers and frequent stoppages occurred in the chutes from the bunker to the pulverizing mills, especially at the Riverside generating station. It was decided that a thorough study of this problem would be warranted and an experimental program was mapped out and carried through in the following steps:

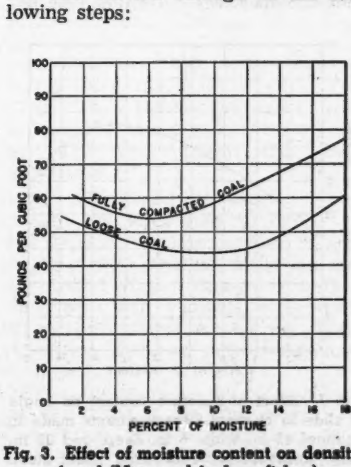


Fig. 3. Effect of moisture content on density of coal (Measured in 1 cu ft box)

1. Study of the flow and stoppage of coal in a transparent plastic scale model of one of the present chutes.
2. Measurements of physical properties of lot coal to study the cause and factors affecting stoppage.
3. The development in successive steps of a new design of coal chute in scale-model form.

Statement of Problem

It has been observed over a number of years that coal will stick in bunkers and chutes whenever the moisture content exceeds a certain limit for given types of equipment and coal. Stoppages when using lot-storage coal, have been more frequent at our Riverside plant than at our other plants, principally on account of the method of storing coal at the former location. The stocking-out and reclaiming of coal by means of a bulldozer and "carry-all," and the greater degree of compacting that the coal undergoes when stored by this means, is apparently responsible for a higher percentage of fines and, consequently, a greater ability of the coal to retain moisture.

The fuel used at these stations is semibituminous coal produced in District No. 1 from the central Pennsylvania and northern West Virginia regions.

Study of Flow of Coal in Scale Model of Existing Chute

Since it was impossible to determine either the exact location or the nature of each stoppage in the coal chutes at the plant, it was decided to make an exact transparent scale model of one of the existing chutes. This and most of the later models were fabricated from 30-mil sheet pyralin by molding it under boiling water over polished wood templates which conformed to exact inside dimensions. This material is satisfactory for this purpose since it has a coefficient of friction not greatly different from smooth steel plate. The lineal scale selected was one tenth full size, which is equivalent to a volume reduction of 1000 to 1.

It was determined that all the phenomena which had been noted in the actual coal chute at an observed moisture content of between 5.5 per

*Abstract of paper presented before the Metropolitan section of the ASME on May 7, 1945.

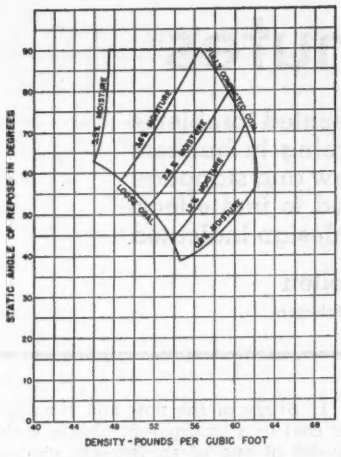


Fig. 4. Effect of moisture and degree of compacting on static angle of repose (Degree of compacting is expressed in terms of change in density for coal of five different moisture contents from 0.8 to 5.5 per cent)

cent and 6 per cent occurred in the model between 3.5 per cent and 3.75 per cent moisture content. It is recognized, therefore, that a scale factor exists but that the scale effect will tend to give model results on the conservative side.

Physical Properties of Coal

To determine the cause of the stoppages which were observed in the model and in order to effect improvements in design, it was found necessary to make quantitative measurements of those physical properties which seem to govern the flow of coal. The ratholing, arching, and sticking were found to be closely associated with three mutually interrelated characteristics, namely, moisture content, degree of compacting, and uniformity coefficient. The gradation of the coal affects the amount of moisture which can be retained and also the possible degree of compacting.

In these discussions the term "loose coal" is being used to indicate that the coal was placed loosely, one scoopful at a time, and every attempt was made to avoid compacting. The term "fully compacted coal" implies that the container was filled with coal and vibrated by mechanical means until no further change in volume could be observed.

From the investigations, it is evident that it is important to use the steepest possible angles, preferably 75 deg or more, in the design of coal chutes if moisture contents higher than 3 per cent are encountered. All of the tests have indicated that the degree of compactness or density of the coal greatly affects the flow characteristics.

DENSITY OF LOOSE AND FULLY COMPACTED COAL WITH VARIOUS MOISTURE CONTENTS—Weights have been plotted for loose and fully compacted coal in Fig. 3.

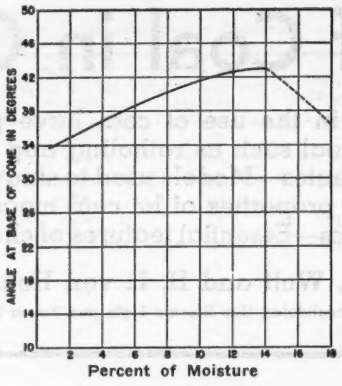


Fig. 5. Effect of moisture content of dynamic angle of repose

EFFECT OF MOISTURE CONTENT ON DEGREE OF COMPACTING OF COAL—To gain a better understanding of the interrelation of moisture content and degree of compacting additional tests were made, and the information is plotted in Fig. 4.

DYNAMIC ANGLE OF REPOSE—Another series of tests was carried out in which the coal was permitted to fall through a 2-in-sq opening in the bottom of a 1-cu ft box. The angle of the cone formed by the loosely falling coal is plotted in Fig. 5.

ANGLE OF SLIDE OF COAL WITH ONE PER CENT TO 16 PER CENT MOISTURE CONTENT ON VARIOUS METAL AND NONMETALLIC SURFACES—The suitability of various materials for coal chutes was studied. The angle at which coal will slide off these various materials is one indication. A large plate was arranged in such a fashion that it could be raised slowly from the horizontal position. Various materials were attached to this plate and equal amounts of loose coal carefully placed along the top part of each material. The angles of slide are plotted in Fig. 6.

These slide tests represent unrestricted flow with one surface of contact. The influence of three contact surfaces was determined by using channel-shaped metal chutes, Fig. 7. This figure shows that the slide-angle curve for steel also has a maximum value.

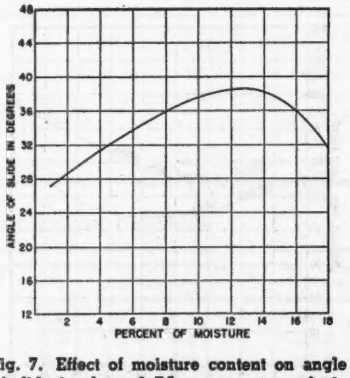


Fig. 7. Effect of moisture content on angle of slide in channel (Measurements made in channel 12 in. wide, 6 in. deep, and 36 in. long, formed from cold-rolled sheet steel. (Depth of coal in channel 2½ in.)

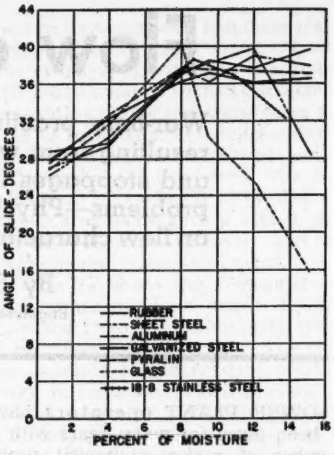


Fig. 6. Effect of moisture content on angle of slide on plane surfaces

A series of experiments was also performed with cylindrical pyralin, glass, and steel tubes to determine the variations between the foregoing conditions and one in which no free surface of coal exists.

Test points have been incorporated on the graph shown in Fig. 8, and an average curve has been drawn to show the trend. It will be noted that

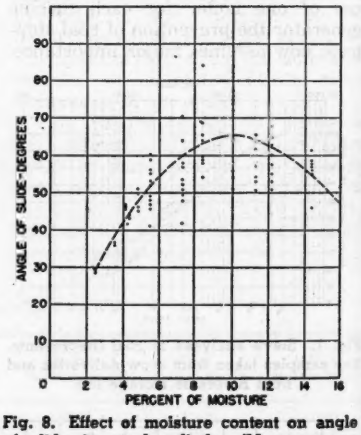


Fig. 8. Effect of moisture content on angle of slide in steel cylinder (Measurements made in 3-in. diam steel tube, 36 in. long)

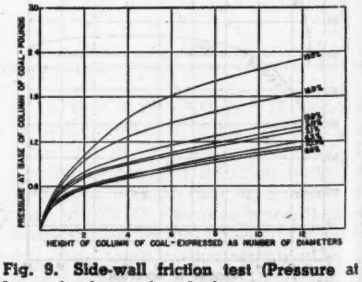


Fig. 9. Side-wall friction test (Pressure at base of column of coal of various moisture contents measured at successive heights in 3-in. diam steel tube, 3 in. high)

the angle of flow increases until it reaches a maximum at 10 per cent moisture and decreases thereafter.

At least three types of flow have been observed in these experiments, which account for the nonuniform behavior in the intermedate moisture ranges, as shown in Fig. 8, and are as follows:

Granular flow, in which there is distinct movement of one particle with respect to the others, occurs with fairly dry coal.

Plug flow, in which the whole column of coal moves as one mass with no apparent relative movement of individual particles, occurs at high moisture contents.

With moisture contents corresponding to the trough of the "density-moisture curve," Fig. 3, there exists a transition type of flow which resembles viscous flow.

The transition from granular flow to plug flow cannot be clearly defined and is influenced by the physical composition of coal. In this region of change in type of flow, it was difficult to obtain reproducibility in many tests.

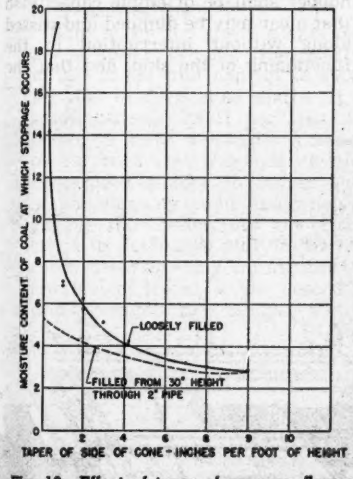

MOISTURE CONTENT OF COAL AT WHICH STOPPAGE OCCURS
LOOSELY FILLED
FILLED FROM 30" HEIGHT THROUGH 2" PIPE
TAPER OF SIDE OF CONE - INCHES PER FOOT OF HEIGHT

Fig. 10. Effect of taper of cone on flow of coal (The moisture content at which stoppage occurred was measured in concentric steel cones of varying tapers, 2-in. diam at outlet and 12 in. high)

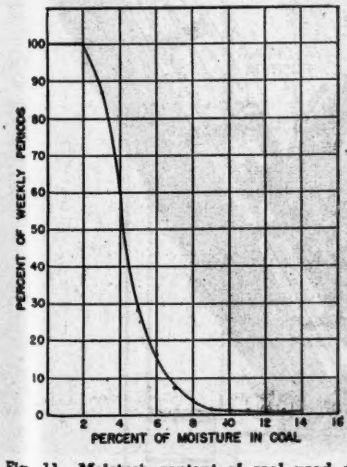


Fig. 11. Moisture content of coal used at Riverside plant (Cumulative per cent of weekly periods with moisture content of coal above given amounts)

FLOW OF COAL IN PIPES WITH UNIFORM AND ENLARGING DIAMETERS—Stoppage occurred in a 3-in. cylindrical pipe at 7 per cent moisture, while a tapering pipe was capable of carrying coal of any moisture content up to the limits of the test (16 per cent).

EFFECT OF PARTIAL OBSTRUCTION OF OUTLETS TO COAL CHUTES—Observations were made on the effect of small obstructions on the angle of slide in cylindrical steel tubes. It was noted that, above 4 per cent moisture content, a very small restriction at the end of a pipe, either in the shape of a small segment, or in the shape of a minute annular ledge, was sufficient to raise the angle of slide to 90 deg, or even to prevent flow in a vertical position.

SIDE-WALL SUPPORT OF COLUMN OF COAL BY SMOOTH CYLINDRICAL PIPE—During the model tests, the vertical load that the coal exerted at the bottom of the chute system was measured. It was found to be equal approximately to the weight of a column of coal 1 diam in height. Basic tests were made to determine the influence of a given head of coal in producing flow through a chute. All curves, plotted in Fig. 9 show a fairly uniform rise up to 1 diam and then flatten out considerably, showing a very small gain in pressure on the bottom from addition height of column.

CONSTRICTING CHUTES OR HOPPERS—The curve representing the moisture content at stoppage in cones of varying tapers increases rapidly with the increase in steepness of cones, Fig. 10. With the sharp angle cones it was possible to re-establish flow by further increase in moisture content. The pronounced effect of compacting on the stoppage of coal in hoppers may be seen by a comparison of the two curves in this figure.

EFFECT OF ADDITION OF OIL AND WETTING AGENTS ON FLOWING PROPERTIES OF COAL—The use of admixtures to lubricate the sides of a chute was considered and various experiments were made to establish the effect of oils and wetting agents. No appreciable improvement of practical value was obtained with these admixtures.

Revised Model Design

With the basic data available, it was decided that improvement to the existing chute system could be accomplished without change in the arrangement and controls of feeders or without alterations of any main structural members or mechanical equipment.

From the shape of the curve showing variations in moisture content of coal during the operating year, Fig. 11, it may be seen that a moderate

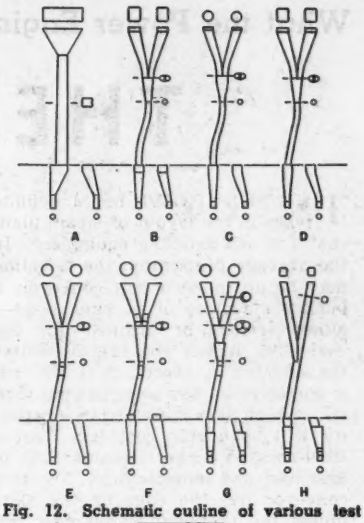


Fig. 12. Schematic outline of various test assemblies

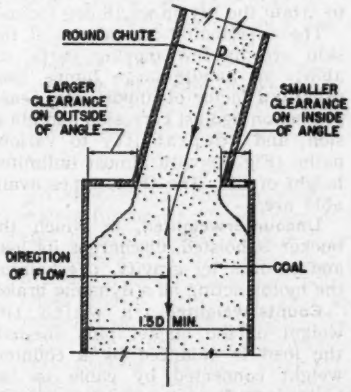


Fig. 13. Schematic sketch of "Breakaway" (Typical flow of coal at change in direction)

improvement in chute performance actually represents a considerably decrease in the number of days in which trouble may be expected. It was with this thought in mind that the redesign of the experimental coal chute was begun.

Successive steps of new design incorporating certain features, to be mentioned, were tried in model form. Essentially these features are intended to approach streamlined flow of the coal similar to the flow of fluids in an efficiently designed system and are:

1. Avoidance of sudden constrictions and sharp changes in direction.

2. Minimum angles of convergence of lines of flow, preferably approaching zero.

3. Minimum practical taper in hoppers.

4. Maximum possible angle of inclination with horizontal throughout the system.

5. Use of round shapes in preference to square or rectangular shapes.

Altogether 40 setups were tested covering the full range from a large,

(Continued on page 100)

What the Power Engineer Needs to Know About

THE SKIP HOIST

THE SKIP HOIST has a definite place in the layout of steam plant coal and ash handling equipment. In the average proposition the selection may be an inclined belt conveyor, a bucket elevator, or a skip hoist—either vertical or inclined—for the coal. The higher the lift the better the skip fits in, especially if the coal is corrosive or has been treated with oil. A high skip hoist of large capacity will as a rule cost less than a steel-encased bucket elevator, both in first cost and maintenance. The belt conveyor has the edge on the skip, unless the property layout does not readily provide the space necessary to attain the lift on an 18-deg incline.

The outstanding advantages of the skip are its few moving parts, its ability to handle large lumps (not usually a factor of importance), easy protection against corrosion and abrasion, and adaptability to various paths (Fig. 1) with almost unlimited height of lift. The three types available are:—

Uncounterweighted, in which the bucket is hoisted, discharges its load and returns by gravity, overhauling the motor acting as a dynamic brake.

Counterweighted, in which the weight of the bucket plus one-half the load is balanced by a counterweight connected by cable to the hoist drum to move in the opposite direction to the bucket. Thus the motor is subjected to a maximum load equal to one-half the useful load, and may be about one-third as large as in the unbalanced skip.

Balanced, which has two buckets moving in opposite directions, thus nearly doubling the capacity with a given size of bucket with corresponding increase in size of motor, or a motor of the same size as required for a counterweighted skip of equal capacity, though the hoisting machine may be lighter and less costly.

Steam plant skips usually are fitted with automatic loaders of which there are three types available: a—The damming type controls the flow of the material into the bucket, but the skip will, unless stopped, continue to operate whether or not there is material in the hopper. b—The full-bucket-control type, Fig. 2, with which the material flows from the hopper until the bucket is filled, then the mechanism starts the bucket upward. But the bucket will not start unless it has been filled, thus there are no useless trips with the bucket only partly loaded or empty. This is the best type of loader for power plant work. c—The weight-of-load-in-bucket type which permits a certain predetermined weight of material to flow into the bucket, then it starts upward. The control thus depends on *weight,* not volume. It is specifically intended for skips handling materials of different weights successively.

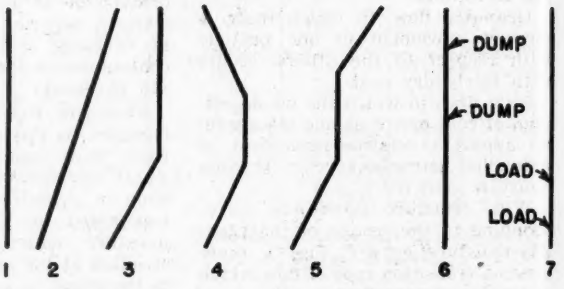


Fig. 1. Typical paths for the skip hoist

1. Vertical; discharge to either side
2. Inclined
3. Incline and vertical
4. C path
5. S path
6. Vertical with two dumping positions
7. Vertical with two loading stations

Above the loader or loaders is the track hopper. It is desirable that the hopper shall be of ample capacity so that a car may be dumped and passed along without interruption in the functioning of the skip, and that the

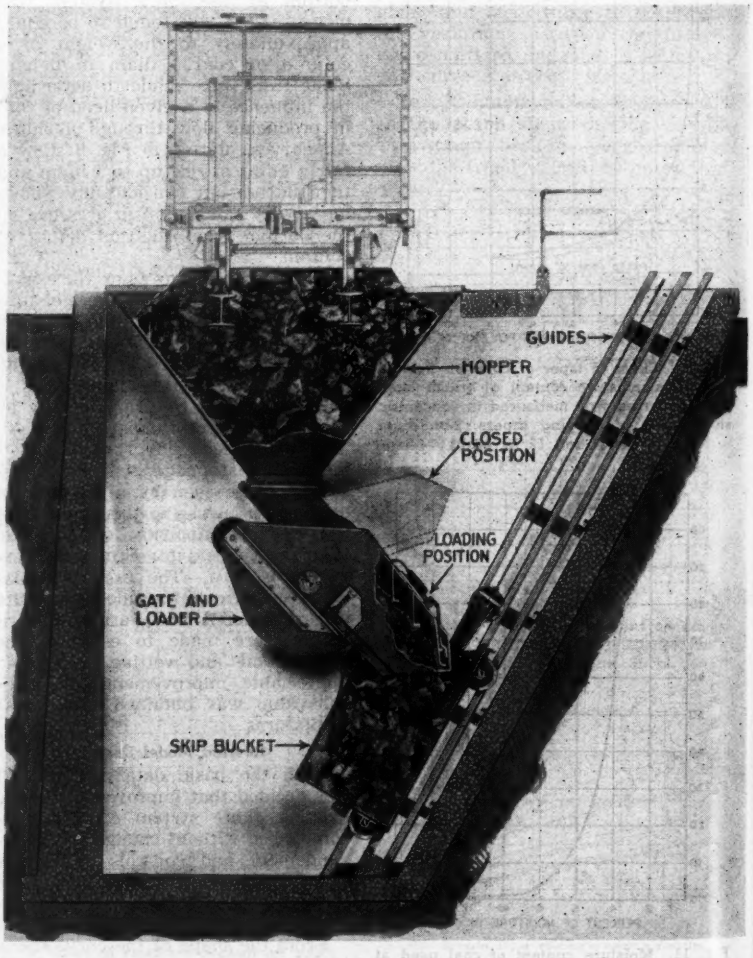


Fig. 2. Full-Bucket-Control type of Automatic Loader. Differing from damming type, bucket does not start upward until material fills bucket to capacity and presses upward against hinged plate, closing contactor on top of loading chute (Courtesy Link-Belt Co.)

What the skip hoist is, various types, how installed, advantages . . . Details of skip hoists . . . How they operate . . . How control them . . . How maintain them . . . Importance of cable maintenance . . . Calculating capacities and selecting proper hoist

By Wilbur G. Hudson

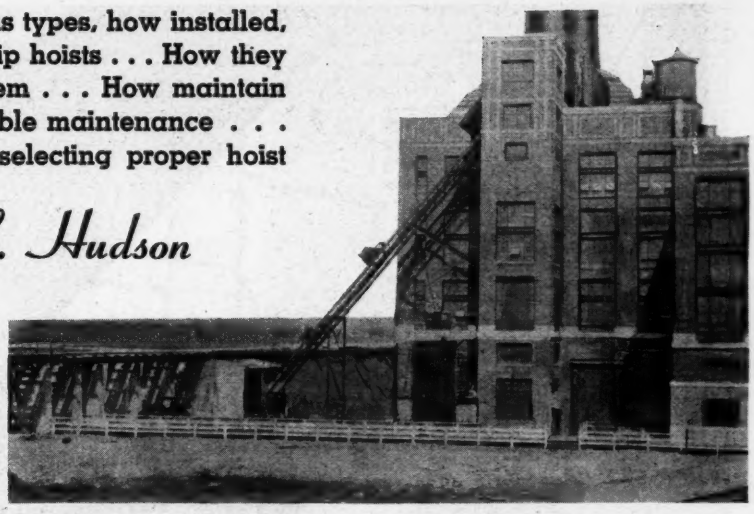


Fig. 3. View of railroad tracks, track hopper, skip bucket and runway at large power station

slope of the hopper sides may be steep enough, as in Fig. 4, to assure the flow to the loader without arching or bridging, especially with the finer sizes of coal.

Skip hoists for steam plants operate at speeds ranging from 80-ft up to 300 ft per min and up to 3000-ft per min in deep mine shafts. If the speed exceeds 200-ft per min it is better to have automatic slowdown of the bucket at the ends of travel (two-speed motor) to reduce shock at the dumping point and when engaging the loader. As the bucket starts to dump, the pull on the hoist cable drops sharply during the last few feet of travel, so the descending counterweight is arranged so that part of the weight is lifted off by fixed brackets at that point. Spring connections between weights and cable assist in reducing shock.

Skips for Ashes

Except for the pivoted bucket carrier, the skip hoist is the only elevator that should be used for the dual duty of coal and ash handling; however, it is better to use separate machines. Then the ash skip is semi-automatic since the routine procedure is to bring ashes to it by small end-dump cars. If the ashes are dry, it is advisable to encase and vent the skip runway so the dust will be drawn upward by chimney action and reduce, in part at least, the dust nuisance. If the ashes are wet and corrosive, the skip bucket may be lined with replaceable cast iron plates or similar resistant material.

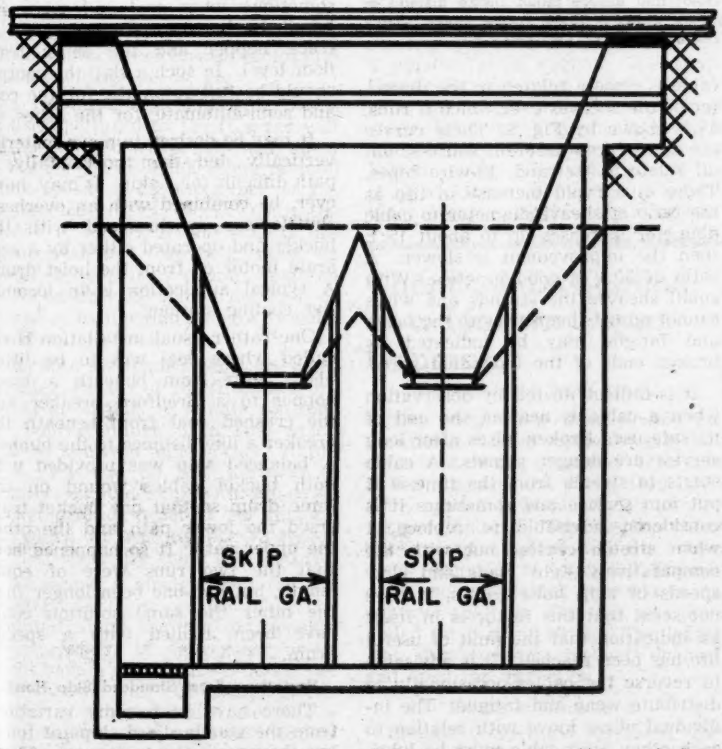


Fig. 4. Steep-sided track hopper for balanced skip, to handle minus ½-in. coal. Dotted lines show flatter slopes suitable for free-flowing coal

The Hoist

The hoisting engine, which accounts for nearly 75 per cent of the cost of a high class skip, is a carefully engineered unit. Usually it has a drum with machined and polished cable grooves, keyed to a heavy shaft mounted on three anti-friction bearings. The intermediate shaft has two anti-friction bearings permitting slight endwise motion to center the herringbone gears. The high speed shaft is direct connected through coupling to the motor, and has anti-friction bearings designed to take any end thrust from the floating rotor of the motor. All bearings are automatically lubricated and outside bearings are sealed.

The motor coupling forms the brake wheel of the solenoid brake, which locks the drive as the motor is reversed at the lower end of the lift. The bucket does not bottom when loading, but is held by the hoist cable clear of the floor of the pit; otherwise the slack cable switch might open the motor circuit. This brake functions also if the current should fail, if the cable should slacken, or if the bucket should over-run at the top of the lift. The brake may be operated by a small motor as seen in Fig. 5.

In smaller installations the bucket travel may be controlled by an upper and lower hatchway limit switch, but in major installations these serve only as emergency over-travel stops, and operating control is centered in a reversing cam mounted on a spindle driven from the drum shaft. The cam limits the travel of the bucket in either direction, and the contacts are easily adjusted to compensate for

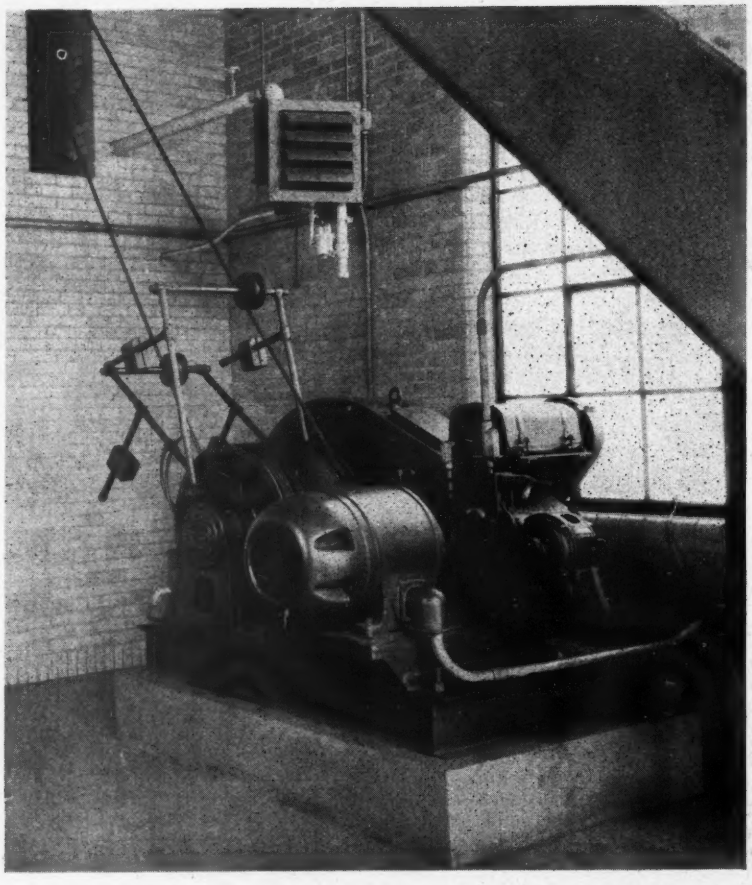


Fig. 5. Hoist unit with enclosed fan-cooled motor and tongue motor brake instead of usual solenoid brake. Traveling cam limit switch directly above brake motor. Slack cable switch arms rest on each cable. (Courtesy Link-Belt Co.)

cable stretch. The control panel, through which the cam switch functions in a semi-automatic or full-automatic skip, is provided with full-magnetic controls and overload and under-voltage protection. The motor usually is a high-torque spirrel cage, or with direct current, a compound wound machine.

A three-point push button station enables the attendant to stop the bucket, cause it to continue or to return to loading position.

Infrequently the descending bucket or counterweight may stick in the guides, permitting the unwinding cable to slacken off. Slack cable protection is provided by lever switches resting on the cables as seen in Fig. 5, which promptly stop the motor and apply the brake should slack occur.

A well-designed, well-built skip engine will operate for years with no other attention than a periodic checking of the solenoid brake adjustment and the internal connections of the travelling cam limit switch.

Cables and Sheaves

The vulnerable part of a skip hoist is the cable. If it lets go a smash-up is probable. The working life of a cable is closely related to the diameter of the sheaves over which it runs, as is shown by Fig. 6. These curves are from three different sources, but all relate to 6-strand, 19-wire ropes. There is a rapid increase in life as the ratio of sheave diameter to cable diameter increases up to about 15:1, then the improvement is slower. A ratio of 30:1 is good practice. With small sheaves the strands and wires cannot adjust themselves to the bend, and fatigue may be indicated by broken ends of the individual wires.

It is difficult to tell by observation when a cable is nearing the end of its safe use. Broken wires after long service are danger signals. A cable starts to stretch from the time it is put into service and sometimes it is considered advisable to replace it when stretch ceases; but with the comparatively light loads and slow speeds of skip hoist cables, it does not seem that this factor is in itself an indication that the limit of useful life has been reached. It is advisable to reverse the cables occasionally to distribute wear and fatigue. The individual wires move with relation to each other, so a cable must be lubricated. Hemp center ropes have a reservoir for the lubricant applied when manufacturing, but lubrication must be repeated at intervals, and the lubricant should be one which will be "assimilated" by the outside adhesive lubricant. The cable should be cleaned with gasoline before applying the lubricant if there is any indication of surface rusting or embedded dirt. If a cable is kinked or twisted the wires may be damaged permanently.

Sheaves should be in lateral alignment with the run of the cable. The guide sheave ahead of the drum should float and be as far as possible from the drum because the alignment changes as the cable winds or unwinds. If the groove of the sheave is of too large a radius, the cable will flatten. If too small, the cable will pinch and abrasion will occur. The head sheaves usually are in an inconvenient location and anti-friction bearings are well worth their much higher cost. Next to improperly balanced loaders, head sheaves and their bearings constitute the maintenance item most likely to call for attention in a machine which, all things considered, does its job with remarkably little servicing.

Usually a skip hoist has a vertical or steeply inclined straight run (1 and 2, Fig. 1). Change in direction of bucket travel is avoided where possible if this involves the introduction of cable guide sheaves, as each additional sheave means reduced cable life. Two discharge points (6—Fig. 1) are seldom required. Two loading points (7—Fig. 1) are needed sometimes when coal and ashes are handled, the first from beneath a track hopper and the ashes from floor level. In such a skip the control should be full-automatic for the coal and semi-automatic for the ashes.

It may be desired to move material vertically and then horizontally, a path difficult for a skip. It may, however, be combined with an overhead shuttle car synchronized with the bucket and operated either by a separate motor or from the hoist drum. A typical application is in locomotive coaling stations.

One rather usual installation is recalled where coal was to be lifted about 80-ft from beneath a track hopper to a Bradford breaker and the crushed coal from beneath the breaker a like distance to the bunker. A balanced skip was provided with both bucket cables wound on the same drum so that one bucket traversed the lower path and the other the upper path. It so happened here that the two runs were of equal length, but had one been longer than the other the same solution could have been applied with a special drum.

Variations From Standard Skip Hoists

There have been some variations from the standardized skips of today but they seem not to survive. There was the vertical skip bucket which

did not tilt but had a hinged trap door held shut or released by a guide rail. There was the skip with a four-wheel carriage in which a pivoted bucket was suspended. This permitted a horizontal run through a basement along the ash-pit fronts, then an upward turn to discharge point while the bucket remained upright. There was the inclined skip with motor mounted on the rear end of the bucket thus eliminating cables and sheaves. The incline must be flat or the bucket will skid backward.

There is a very good variation for skips of small capacity which eliminates the costly hoist unit. At the head is a motorized reducer with twin sprockets mounted on an extended shaft. Sprocket chains lead from the top of the bucket up over the sprockets and down to the bottom of the bucket—somewhat like a bucket elevator with a single bucket—but it ascends, discharges and returns to loading position by control of top and bottom limit switches. This assembly costs about one-fourth as much as the standard hoisting engine, and is nicely adapted for the small steam plant with a daily output of a few tons of ashes per day, or for any other operation where small capacity and semi-automatic operation are involved.

Selecting the Proper Skip Hoist

The engineer contemplating the application of a skip hoist for elevating coal in his proposed plant, must consider several factors—speed, power, type of skip, type of control. Suppose the desired capacity is 70 tons per hour, lift 120 ft, path 5, Fig. 1. The manufacturers furnish tables giving capacities, speeds, etc.

A full-automatic skip with 120-cu ft bucket geared to 130 ft speed will do the job. So will a skip with 80-cu ft bucket geared to 160 ft per minute. Slow speed is advantageous as the engagement of the bucket with the loader is softer. If the skip is uncounterweighted, we will need 62 motor hp. If it is counterweighted we need only 20 motor hp, and, of course, a lighter and less costly hoist machine.

Suppose the requirements are more complex:—a lift of 160 ft, path 2, inclined at 70 deg, to handle 150 tons per hour of minus ¼ in. coal which will be received in 4-pocket, 70-ton cars. We can do this job with a counterweighted skip with 200-cu ft bucket geared to 260 ft per minute, for which we will require 73 motor hp; but there are some bad features.

To secure a straight run for the counterweight, its guides might be mounted along the top of the skip bridge, which is dangerous; or it might have a run vertically along the boiler-house wall by hanging the weight in a bight, which means one more bend in the cable and double the counterweight—about 15 tons in this case. Again, the track hopper must be extremely deep for the sides to converge from the length required for the four-pocket cars to the dimensions of a single loader. We will consider the alternative of a balanced skip.

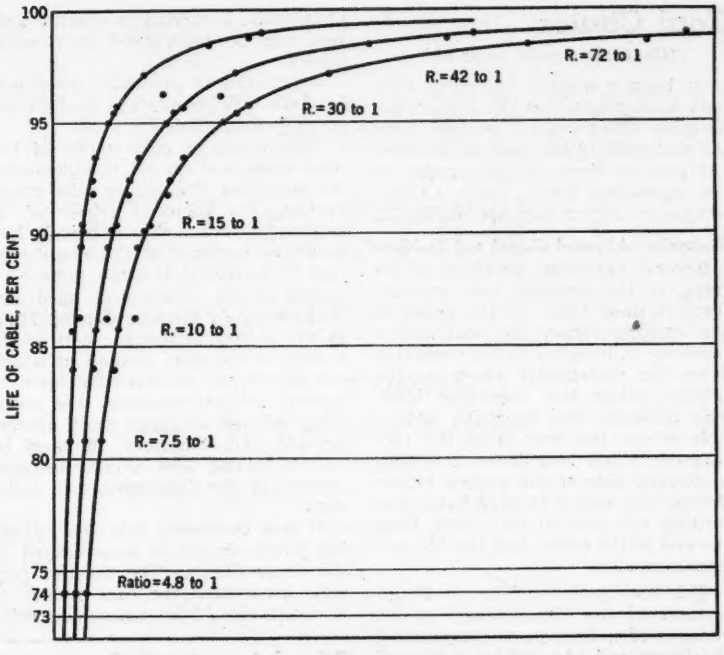


Fig. 6. Life of 6-strand 19-wire rope as related to sheave diameter (determined by three independent tests.) Life of straight rope—100%

The desired capacity is attained with a two-speed balanced skip with 100-cu ft buckets at about the same hoisting speed and motor hp, but with a smaller hoist engine. The track hopper for the twin loaders will be as in Fig. 4 with a length of 24 ft at track level to accommodate, with some leeway, the spacing of the car bottom gates. The sides should be steep and it may be necessary to provide vibrators against the plates if the coal is sluggish, as probably it will be.

A well made, properly erected skip hoist makes few demands on the maintenance crew. As the hoist cable stretches, the limit switch must be adjusted to suit. The cables must be lubricated thoroughly at intervals, examined for bad spots, and eventually reversed and shortened. The solenoid brake must be adjusted infrequently. Most important, the balancing of the automatic loader must be correct. If overbalanced, there is shock as the bucket lugs engage. If underbalanced, it may drop after the bucket ascends.

Chemical De-Scaling of a Modern Steam Generator

(Continued from page)

The vents were then closed, the blowdown valves opened, and hot deaerated water pumped into the boiler through the main feed line. This operation required 1½ hr to remove the acid. The flushing process was then halted and the water level dropped to normal. Enough soda ash was added to make a ½ per cent solution. The unit was then boiled for 3 hr at 10 psi. The boiler was then pressure flushed, drained and open for inspection.

Results of Treatment B

Internal inspection revealed the metal to be clean and bright with no adhering scale on the surface and no evidence of corrosion. Table VI gives the actual results of the treatment.

This pressure flushing process removes practically all disintegrated material from the boiler and aids in the prevention of after corrosion, by excluding air from the clean hot metal surfaces.

Figure 2 gives an indication of the reliability of this unit. During the calendar year of 1944 the boiler was in service 98.4 per cent of the time, the only outage being for annual inspection and acid cleaning. During 1943 the "Availability Factor" was 97.5 per cent. In addition to the annual inspection and acid cleaning an eight hour forced outage for electrical trouble was encountered.

With the practicability of chemical cleaning definitely established, The Dow Chemical Co. is contemplating a 500,000-lb per-hr boiler at 1250 psi, this boiler to be designed with small tubes which cannot be cleaned mechanically.

Coal Chutes

(Continued from page 95)

long hopper section spanning over both bunker gates at the top, to the extreme of two pipes leading from the coal gates in the most direct manner possible down to the hopper at the operating floor. These various setups are in part depicted in Fig. 12.

Discussion of Special Shapes and Problems

Several individual problems of interest to the designer were encountered in these tests. In the model of the existing chute, the coal had a tendency to hang up at the transition from the rectangular chute to the hopper below the operating level. This difficulty was especially noticeable where the flow from the rectangular chute was directed against a slanting side of the hopper below. Where this hopper stepped back, permitting the coal to fall away from the end of the chute, less trouble was encountered.

This observation led to the development of the "breakaway," which consists of a free space surrounding the lower end of a chute or hopper, thereby permitting the coal flowing from the chute or hopper to break away freely in all directions, Fig. 13. This feature permits a sudden change in direction and has the added advantage of tending to counteract compacting.

The data gained in the cone experiments indicate that the behavior of a separate conical hopper will differ from one incorporated in a chute system. Tests carried out in the development of the new model further indicate that the performance of such a hopper depends upon its relative position within a system, since this will govern the amount of compacting the coal undergoes.

In general it may be stated that cones of a slight taper, while permitting free flow as individual units, show a tendency to compact the coal by their powerful wedge action when they become part of the system, and whenever the ratio of their lengths to smallest diameter exceeds approximately 2. On the other hand, short cones of moderate slope work fairly well as long as the ratio of their lengths to smallest diameter does not exceed 1.5 to 2.

Concentric cones have an advantage where it is desired to achieve a reduction in cross section while eccentric cones can be employed effectively where both lateral transition and reduction in area are required. Consequently, both have been employed in the final design.

Conclusions

The result of observations given in this paper apply to the particular coal tested and, for similar coal the graphs should be interpreted as indicating probable trends, rather than definite values.

The tests have demonstrated that phenomena occurring in a chute system can be reproduced in a scale model.

Application of principles developed in these experiments can lead to improved chute design.

Compaction of coal is one of the most important factors in influencing the operation of a solidly filled chute system. An angle of repose of 90 deg may be reached at relatively low moisture contents if the density of coal is increased through impact or wedge action. Since coal must undergo a certain amount of compacting in any composite system, there exists a limit in moisture content at which the chutes can be depended upon to operate without stoppage. The possibility of coal stoppage must be recognized and, therefore, the ease of re-establishing flow should be considered in the development of a design.

It was concluded that the following points should be incorporated in the chute design. The shortest possible path from the coal bunker to the mills should be maintained. Tapered (or uniformly enlarging) round chutes should be used wherever possible. Where two streams of coal must be brought together, this should be accomplished with a minimum angle of convergence. If a sudden change in direction cannot be avoided, the introduction of a "breakaway" to help the coal to realign itself should be utilized. All angles of chutes should be made as steep as possible and reductions in cross section kept to a minimum.

The application of all points mentioned in the foregoing has resulted in a model design which showed sufficient improvement over the model of the existing chute to justify the construction of a full-sized chute for development of actual field experience.

This investigation has concerned itself entirely with the possibilities of improving flow of coal in an existing chute system and does not take into account the problem of maintaining uninterrupted flow of coal from bunker to chutes, but the latter is now under investigation.

Machine to Solve Mathematical Problems

MATHEMATICAL PROBLEMS which would take several years to work by conventional methods are now being solved in a few days, at the General Electric plant, by use of a recently perfected differential analyzer.

This machine, consisting of an interconnected system of shafts, motors and gears, employs mechanical elements for addition, subtraction, multiplication and division, and electromechanical elements for more complex functions. Practically all of the gears and couplings are removable and must be set up in a different arrangement for each new problem.

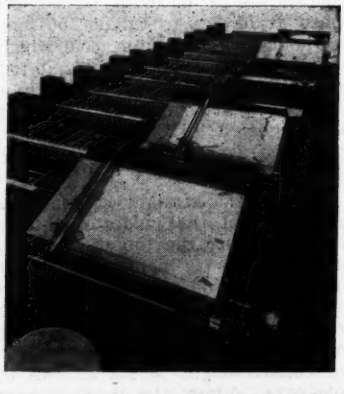
According to scientists, almost any physical phenomenon can be expressed in terms of differential equations. Since this G-E analyzer is fundamentally a tool permitting rapid solution of such equations, it can be used to solve many problems of an important nature whose correct answers were until now only guessed at.

Most important element of this new analyzer is a polaroid photoelectric system of unique design which G-E developed. Fourteen of these highly sensitive devices are installed on the machine, thus permitting the accurate, speedy solution of differential equations requiring as many as fourteen simultaneous integrations.

In appearance the G-E analyzer resembles a long maze of shafts and gears with four input tables and two output tables extending to one side. When the machine is in use, the variables in the differential equations being solved are represented by the rotations of shafts in the machine. These are connected with mechanical pens on the output tables. As the shafts speed ahead to solve the equation, they move the pens which, in turn, plot an accurate curve in accordance with the quantities worked out by the continuous movement of the shafts. Interpreted correctly, this curve gives a graphic solution of the problem.

Before the analyzer is put into operation, the problem must first be set up on the machine. To do this, necessary equations are arrived at and various shafts and gears are interconnected so that all the quantities in the problem will be represented. Then, after the wizard machine is set to work, technicians may grind into it by means of the input tables required mathematical functions, if more are needed, to obtain a final solution.

Differential analyzers of a type similar to the G-E device were first developed by Dr. Vannevar Bush, formerly of Massachusetts Institute of Technology. Later the Moore school of the University of Pennsylvania and M. I. T. made modifications and further improvements.



Oblique side view of differential analyzer showing input and output table assemblies

The
PRACTICAL ENGINEER and ELECTRICIAN
ANDREW W. KRAMER, EDITOR

Experience As An Investment

EXPERIENCE is like any other investment: there must be something behind it, something that represents value, and that something is knowledge. A moment's reflection will show that to be of any worth experience must be interpreted; and that criticism—interpretation—to be of value should be based on something more reliable than previous uncriticized experience.

The practical man interprets new experiences by his earlier ones, a method which is like trying to lift oneself by one's boot straps. As a result of former experiences, a man formed certain habits of thoughts, acquired definite fixed convictions, and has come to certain conclusions associated with them and an unconscious antipathy to opposing opinions. Later he measures the value of a new experience by the same habit of thought, the same convictions and conclusions which he has thus acquired. Of course, the measurements will agree, since such a man uses the same personal yardstick, but these measurements are inaccurate, because the wishes and desires derived from his first experience determine the length of his yardstick for future experiences, regardless of the measures used by other people. This explains why the experiences of two often disagree.

They used different yardsticks in making their estimates.

A few of the more alert men are beginning to see that experience is what they make it, that its returns depend upon their investment in study, investigation and reflection. These men have found uncriticized experience so wasteful that they become suspicious of it.

Edgar James Swift Business Psychology

Submitted by
A. L. Goyette, W T 1/c U. S. Coast Guard

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INTERPOLES on D-C Motors and Generators

By Capt. Eugene George Key

COMMUTATION is a problem which many practical men consider too difficult to try to understand. Actually, some of the principles involved are not complicated and should be understood by all men (and women, today, with our WAC personnel doing much of the work of men) who maintain direct current motors and generators.

A few general principles of electricity and magnetism on which commutation problems depend should be reviewed first.

PRINCIPLE 1. Magnetism generates electricity and electricity generates magnetism. Whenever a moving wire passes through a stationary magnetic field, an electrical voltage is generated in the wire. Similarly, when a moving magnetic field crosses a stationary wire, a voltage is generated in the wire. When a current is thus "induced" in the wire, it produces a magnetic field around the wire that opposes the action of the field that produced the voltage. The higher the current that flows through the wire, the stronger is the magnetic field produced by it and the stronger is the opposing force that is exerted against the original field. Except for the law of conservation of energy, the current flow could be constantly increased until these magnetic fields would completely neutralize each other. Since this point is never reached, each field distorts the other. This is the condition in an electric machine. This field distortion is one of the most serious difficulties involved in commutation in a direct current motor or generator.

PRINCIPLE 2. The magnetic field produced by the current flowing in a wire always acts in such a way as to prevent a change in the amount and direction of current flowing in that wire. When zero current is flowing, there is, of course, no magnetic field around the wire. As current starts to flow, this field starts to build up. Its effect is to hinder or resist the flow of current in the wire. When a steady current flow is established, the magnetic field has no effect on this current. If a switch is suddenly opened, however, the current starts to decrease, but the magnetic field changes, also, and in such a way as to cause the current to continue flowing. The result is a spark between the blades of the switch, amounting in some instances to a heavy arc.

These are the two principles involved in direct current commutation. They will be referred to as "P. 1" and "P. 2," that is, "Principle 1" and "Principle 2."

In Fig. 1a is shown a picture of a commutator—including brushes and coils—as if the commutator were a straight line instead of a circle. The field poles are indicated by N for North and S for South. No interpoles are shown. In this position no coils are entirely in the space between any two poles although coils A and A' are very close to this position. In Fig. 1, current is flowing through all coils, from brushes A and B.

In Fig. 1b, coils A and A' have come between the poles in a space where, theoretically, no magnetic flux from the poles exists. Since these coils are now under brushes A and B, no current can flow through them. Coil A, for example, is short-circuited by brush A. An instant before, as in Fig. 1a, coil A was carrying the same current as coil B. Short-circuiting coil A acts just like the switch in P. 2. Consequently, the magnetic field that was produced by the current in this coil now acts in such a way as to prevent a change in the current which was flowing in this coil. The result is a spark produced at brush A. A spark will also appear at brush B. A motor usually operates at a speed of several hundred revolutions per minute. Considering a four-pole machine rotating at a slow speed of 200 rpm, each coil will cause a spark 800 times a minute. If there are 50 coils, there are 40,000 sparks per minute on the commutator. This condition is not exceptional. Indeed, most direct current motors used in industry are four-pole machines and rotate at much higher speeds. Not many have as few as 50 coils in the armature. This illustration shows how serious this sparking can be, as a great deal of damage can be done to both commutator and brushes.

If something can be done to neutralize the effect of P. 2, this sparking can be eliminated. One way is to insert additional magnetic fields at I and I', Fig. 1b, of such polarity that the field will neutralize the effect of change which is produced by the magnetic field around the coil.

The polarity of I and I' must be correct, of course. In a motor, current is fed into the armature from the line and rotation is caused depending on the direction of the magnetic field produced by the field poles.

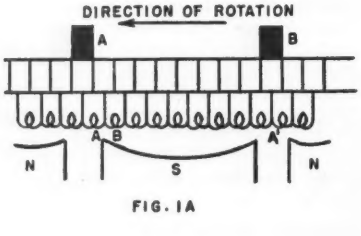


FIG. 1A

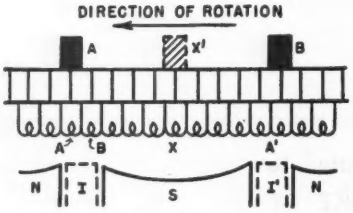


FIG. 1B

Fig. 1. Diagrammatic representation of a commutator to show action of the brushes in short circuiting coils

FIG. 2A

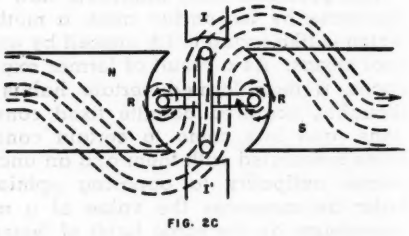


FIG. 2C

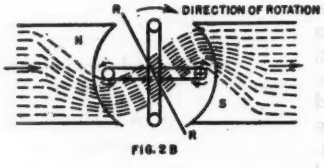


FIG. 2B

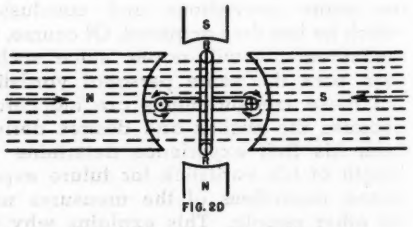


FIG. 2D

Fig. 2. Diagrams showing distortion of field flux by armature flux

The field poles, because of P. 1, cause a voltage to be set up in the armature coils which neutralizes some of the line voltage impressed on the armature. The field around the armature coil tends to cause current to continue flowing in the same direction as the current impressed from the line. Since the regular field poles already oppose this current, the interpoles should be of the same polarity as the main poles. Thus, I should be a South pole and I', a North pole.

P. 1 is an even more serious effect than P 2 as far as commutation problems are concerned. This effect is illustrated in Figs. 2a to 2c.

Suppose a motor field is energized with the armature circuit open. The only effect is produced by the magnetic field generated in the field poles S and N. No distortion results because the armature is not producing a countermagnetic field of its own. Coil A is in the position of coil A in Fig. 1a—just entering the neutral zone R-R.

As soon as the armature is energized, a field is produced around all conductors in the armature except those in the neutral plane, as coil A in Fig. 1a. However, now distortion is beginning to take place. Instead of the magnetic field going straight across from pole N to pole S, this field attempts to follow the course of the field set up around the armature conductors. The neutral plane is no longer perpendicular to the axis of the poles but at an angle as shown in Fig. 2b. Coil A is now under the influence of the magnetic field and, if short-circuited as in Fig. 1b, will generate a voltage of its own which will reveal itself as a sharp flash at brush A.

As armature speed increases or as a load is added, further distortion takes place, as in Fig. 2c. Neutral zone R-R has moved a considerable distance in the direction opposite to rotation. Now, coil X in Fig. 1b is in the actual neutral zone. The effects of shifting of the neutral zone can be partially corrected by shifting brush A to position X' (Fig. 1b). That this method would really prove unsuccessful is obvious from consideration of the following three further effects:

(a) The neutral zone shifts every time the load is changed and no method has ever been developed which will shift the brushes to the new location every time the neutral zone changes in position.

(b) The full effect of the magnetic field is obtained only when it acts as shown by the arrows in Fig. 2a. Distortion does two things: 1. It creates a longer path for the magnetism to travel. 2. It causes the field to use only a part of the pole face (the curved part facing the armature). Both of these effects cause a loss in the strength of the magnetic field. Since electrical power is used in creating a magnetic field, the result is a waste of electrical power. This loss has actually been measured by electrical engineers and found to have considerable effect on the efficiency of the machine.

(c) P. 2 still is uncorrected by shifting brushes.

Interpoles are again the most practical solution to the problem, by using an external field to neutralize the distortion. The polarity of this field, at I and I' in Fig. 2c, can be determined from the first law of magnetism.

The first law of magnetism says: *Opposite poles attract and like poles oppose.*

The field shown in Fig. 2c, following the arrows marked on the pole pieces N and S, produces in effect a North pole at I' and a South pole at I. These are the poles which must be neutralized by the interpoles. Therefore, I' must be South pole and I a North pole.

It will be noticed that in Figs. 1b and 2d, the interpole in the direction of rotation from the main pole is of the same polarity as the main pole, so that identical results are obtained by following either explanation.

An electrician might bring up an objection that some of the magnetic flux will go from the North Main Pole to the South Interpoles. The small amount of flux which follows that path will be negligible, as the air space between main and interpoles offers a much higher resistance to magnetic field than the iron of the armature.

There remains one more consideration regarding the theory of interpoles—the manner in which they should be connected for best results. If they were connected in series with the field poles, the difficulty would be corrected for only one size of load, as the strength of the interpole fields would be constant. The same is true if the interpoles are connected across the line.

Since magnetic distortion depends on the current flowing through the armature, it can be corrected by the current through the armature. Accordingly, interpoles are connected in series with the armature. The amount of correction therefore depends on the amount of distortion.

"I dunno! th' boss said he was gonna stop these birds comin' in late in the mornin' or else!!"

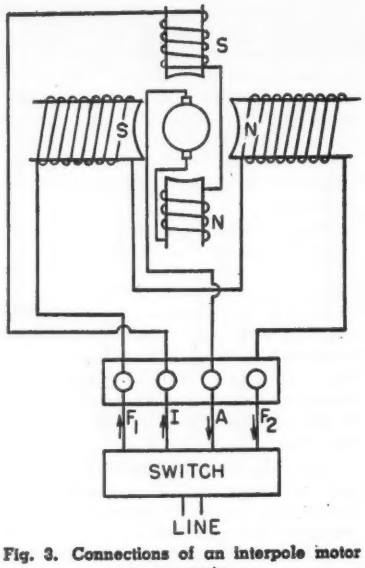


Fig. 3. Connections of an interpole motor or generator

The ideal correction shown in Fig. 2d, however, is never achieved in practice. There are several reasons for this. First, it is economically impractical, as a high percentage of correction is sufficient. An increase in correction beyond this practical point results in decreased efficiency because of the amount of power required to make the correction. The practical limit of correction depends on the type and design of the machine concerned. Second, the amount of correction does not always equal the amount of distortion. At one load, a change in load may result in more correction than distortion. If the ideal correction had been achieved for this load, this condition would result in over-correction with a resulting distortion caused by the interpole field. Third, exact correction cannot be designed into a machine because of the human element in the design problem. A slight error in estimation of the amount of distortion and amount of correction might easily result in over-correction at all loads and consequent loss of efficiency since both distortion and correction uses power that cannot be considered except as a loss.

Figure 3 shows the schematic diagram of a motor connected with interpoles. The two-wire line is fed into the switch which, in this case, has four connections to the motor (actual number varies according to the type of switch). Two of these connections are for the field, F_2 and F_1. The others are for the armature and interpole in series. A check of this diagram will show that if the direction of rotation was reversed by changing the armature-interpole connections, the relative polarity of interpoles and main poles would still be correct.

When a new direct-current motor is being installed for the first time or when an old motor which has been over-hauled is being re-installed, a practical electrician should be able to make most of these connections before even starting the motor.

The direction of rotation is always known in advance. The first thing to do, then, is to connect and energize the field, connect the interpoles in series with a resistance, such as the regular starting resistance. The interpoles can even be connected temporarily in series with the field if the resulting magnetic field at the face of the interpole is strong enough. Then a thin piece of iron or steel can be inserted between the one regular main pole and its adjacent interpole. If the interpole is in the direction of rotation, it should be of the same polarity as the main pole and the result should be a slight opposition. If the interpole is in the reverse direction of rotation from the main pole, it should be of opposite polarity to the main pole and a decided attraction should be the result. When this relationship is definitely known to exist, the corresponding terminals of line and interpoles should be marked.

The next step is to connect the armature in series with the interpoles. If the armature rotates in the wrong direction, the connections at the armature itself should be changed without changing the connections to the interpoles or to the main field poles.

If the machine under consideration is a generator, all theories and connections described in the article are exactly reversed. In a generator, the interpoles should be of the same polarity as the next succeeding main pole in the direction of rotation.

Although the facts and principles discussed thus far in this article are complete, the distortion referred to can be treated in a different manner. Because of the importance of this problem, and the possibility that some readers may still be somewhat puzzled about the phenomenon this explanation is offered.

In Fig. 4a is shown the manner in which coils of a 2-pole armature are connected at the end of the armature opposite the commutator, Coil A-A′ being in the neutral plane, carries no current. The remaining coils, however, are carrying current in the directions indicated, a dot indicating that the current is flowing out from the paper and a cross indicating the opposite direction.

As can be seen, coil B is carrying current in a direction opposite to that of B′. Similarly, all coils shown on the left of A-A′ are carrying current in the same direction and all coils on the right are carrying current in the opposite direction. In effect, then, A-A′ is open-circuited, and the remaining coils can be considered to be connected as shown by dotted lines in Fig. 4b. The magnetic flux around each conductor unites to form a long path, as M in Fig. 4c, forming an effective North pole at N_A and South pole at S_A. These poles are the actual causes of the distortion described, the amount of distortion depends on the strength of N_A and S_A. These poles remain in the same physical location regardless of other effects in the motor, although a fraction of a revolution later, coil B′-F (Fig. 4a) will be in the neutral plane instead of A-A′ and all other coils will take up corresponding positions.

Referring to Fig. 4d and the first law of magnetism, it can be easily seen that interpole I must be a South pole and I′ a North pole to neutralize N_A and S_A, respectively. This checks with the previous results determined earlier in this article.

Occasionally motors will be found with only half as many interpoles as main poles. When this is done, the one pole must be approximately twice as strong as one would be if two poles were used. The results with one pole are not as good as with two, but the saving in iron by the elimination of one interpole is sometimes considered more important than the difference in efficiency.

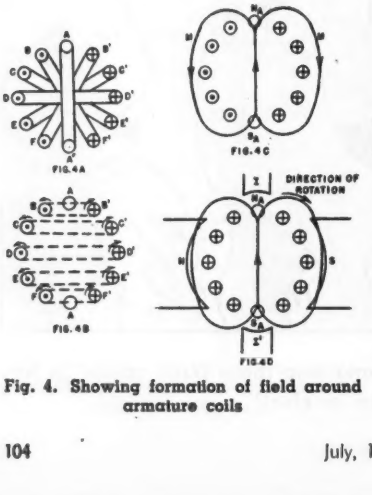


Fig. 4. Showing formation of field around armature coils

No Pilot Exciters

By C. O. von Dannenberg

THE ACQUISITION of an extensive transmission net work when added to an existing system planned along different lines, introduces problems quite unforeseen in nature requiring rather a varied method of approach for its solution.

The generating station involved had been operating with an average load having a lagging power factor. The generators (1925) had direct connected 250-v exciters and having no main generator field rheostats depended wholly upon the variation of exciter field for voltage regulation.

When the added system was connected it included a transmission system, which in addition to its actual load included some 10,000 kva and leading power factor demand. The actual effect was in the lowering of the generator excitation, which at times of light load reduced the exciter voltage to less than 100 v and as a result the situation became very unstable as the slightest system disturb-

ance caused an interruption to service. The generators as constructed did not lend themselves to any simple method of adding a pilot exciter; even the addition of a fixed resistor in the main generator field circuit to raise the exciter voltage and stabilize it was not readily feasible. A third method, however, was put forward and when applied took care of the situation satisfactorily. This consisted in exciting the main exciter field from the station battery and in this way making it independent of system conditions and variation due to changes in the exciter voltage and being at all times of operation, assured of a constant and stable field, for the exciter.

The actual additional load on the station battery was, of course, taken care of through adjustment of the charging unit. Even with the charging unit shut down altogether the additional drain on the battery was small. It was necessary to reconnect the main exciter field to make it suitable for the battery voltage which varied between 120 and 130 volts.

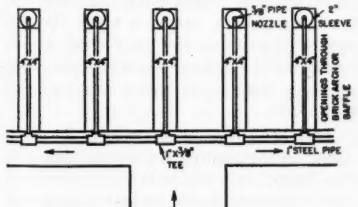
PRACTICAL HINTS AND KINKS

Over Fire Turbulence

By M. J. Schwartz

THE ACCOMPANYING drawing shows the arrangmeent of an installation which has been of great value to us as a smoke eliminator. Previous to its installation we had experienced a great deal of trouble with smoke at this plant. In the construction of the boilers, the designers apparently had intended to have openings from the forced draft air ducts to the furnace to supply over fire air. These openings were to be 4 x 4-in. in area and there were to be five of them.

After a great deal of trouble with the installation, we examined the construction closely and discovered that there was a channel iron running the width of the boiler and this obstructed the air passages. So, instead of having 4 x 4 openings the openings were actually only 2 x 4-in. We also found that one of the openings was completely bricked shut.



After discussing what we could do about the situation, we decided to rearrange the equipment as follows: We took a 1-in. steam line and ran it through the wall of the furnace into the air duct as shown on the drawing. Next we took five ⅜-in. lines and ran them up into each one of these 4 x 4 openings. We put in 2-in. pipe sleeves in the openings above the fire. The sleeves were as long as the width of the bricks, namely, 4-in., and we cemented them in with fire clay. When we were all finished, what we had was a nozzle effect. The ⅜-in. steam line blowing into the 2-in. sleeve, and with 15 lb of steam on the 1-in. line we eliminated the smoke nuisance to such an extent that now the smoke density is better than one, compared with the Ringelman Chart. In other words, there is no smoke only a very light haze. When cleaning the fires we increase the steam pressure to 20 lb and this keeps the stack clear under those conditions.

While I do not have any exact figures, I think this arrangement will reduce our fly-ash trouble about 50 per cent, because we must be burning more of the coal in suspension than we did before. Our Republic draft gages read as follows: Wind box, 0.7 to 0.1; Over fire, 0.07 to 0.1; Last passage, 0.2. At the present time the flue gas temperature runs about 440 degree at 95 lb boiler pressure.

Worn Shaft Reclaimed*

Due to the heavy expense involved, an owner finds himself unwilling to buy a new shaft after one has become worn. And now that there is such a shortage of steel, these parts are even more difficult to obtain, thereby resulting in a delay of operations.

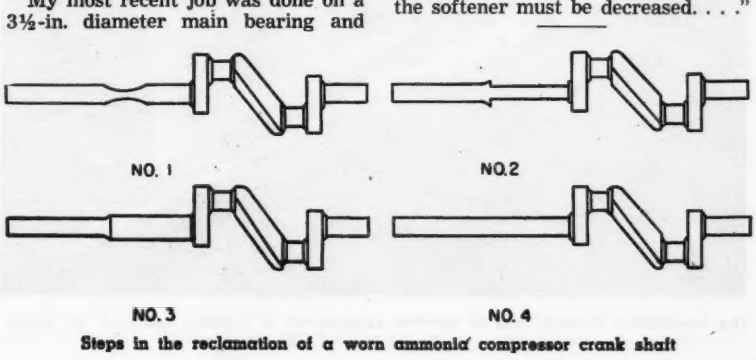
Because of the demand for reclaiming and repairing worn parts, I have developed this new process of arc welding, a crank shaft to make it as good as new, and to save as much as 75 per cent in expense.

My most recent job was done on a 3½-in. diameter main bearing and also the stuffing box of a crank shaft from an ammonia compressor, as shown in the sketch. I own a Lincoln welder and the welding was done with a Lincoln Fleetweld No. 7. However, this jojb can also be done with a Lincoln Shield Arc No. 85.

The secret in giving this worn shaft the appearance of a new one, and also making it equally as durable, is in preparing it for arc welding as shown in diagram No. 2. After it has been machined down as shown in diagram No. 4, the weld becomes completely invisible, giving it the appearance of a brand new part.

A new crank shaft for this ammonia compressor costs $200. My price for reclaiming it was $45, making a saving of $155, and giving a shaft that can take the identical strain and wear of a brand new one. Fort Worth, Tex. D. E. CLAYPOOL, SR.

From a paper submitted by the author in the most recent $200,000 Industrial Progress Award Program conducted by the James F. Lincoln Arc Welding Foundation.



Steps in the reclamation of a worn ammonia compressor crank shaft

Complete Directions for Testing Boiler Water

By Urban C. Fleming, Jr.

Correction Note — In this article, June issue, page 104, there were several discrepancies in the data in paragraphs 4 and 7. The author had previously corrected these on the galley proof but, during our recent change of printers, an uncorrected galley proof was used in the make-up. Our face is very red—if we haven't lost it entirely.

However, please change your copy of the June issue to read as follows:

Page 104, col. 2, line 10. "By maintaining 2P—MO between 0.5 and 1.0 cc, the most favorable results are obtained."

Page 104, col. 2, par. 4 should read: "To illustrate the application of the above formulas let us take an analysis of an effluent from a lime-soda softener:

P reading = 3.2 cc
MO reading = 4.2 cc
H reading = 0.8 cc

In this case,

2P—MO = 6.4—4.2 = 2.2 cc
2 (MO—P)—H = 2 (4.2—3.2)—0.8 = 1.2 cc

"We find from the above information that the valve for 2 P—MO is 2.2 cc and therefore the lime feed to the softener must be decreased. . . ."

The Evolution of Walls

By GEORGE P. REINTJES
President, Geo. P. Reintjes Co.
Kansas City, Mo.

Furnace walls . . . Their purpose . . . What happens when they are heated . . . Similarity between skyscrapers and boiler heat enclosures . . . Solid masonry walls vs. frame construction . . . The development of sectionally supported furnace walls.

As ONE does his day-by-day task involving engineering design or the operation of power-plant equipment, he often loses sight of the fact that all of his work is based upon a relatively few fundamental physical principles. Perhaps the very nature of his specialized work causes him to think in terms of the application of those fundamentals rather than about the fundamentals themselves. When the designer or operator forgets to heed these elemental truths, he may find himself in difficulties.

Everyone knows that a boiler is a machine for converting water into steam. In order to accomplish that purpose, it is necessary to add heat to the water. This heat comes from coal, gas, oil, wood, or refuse fuel which is burned to liberate the heat it contains. We all know that we just can't burn the fuel anywhere and expect the boiler to absorb the heat produced when the fuel burns—the fuel must be burned in a special box, known in modern terms as a heat enclosure, which surrounds the boiler. But many of us don't consider what happens to that box when it is subjected to the temperature of the burning fuel.

The Monadnock Building, one of the first skyscrapers in Chicago and now the Home Office of Power Plant Engineering

It is common knowledge that practically all materials expand when heated. There are some which expand very little, but these are special materials and don't concern us who deal with power plant equipment. The heat-enclosure box must be fabricated from materials capable of withstanding the high temperature of the burning fuel. This material, or refractory, also expands when it is heated, and, consequently, the heat enclosure must be constructed so that it can absorb this expansion or failure results.

Did you ever stop to think how similar are the requirements of a skyscraper and a boiler heat enclosure? It is true, the walls of the skyscraper are designed to keep the heat and cold out and thereby contribute to your personal comfort. The boiler heat enclosure walls keep the heat resulting from the burning of the fuel confined so that it can be utilized effectively. Both are heat controllers —the skycraper keeps the heat or cold out, the boiler heat enclosure keeps the heat in where it can be absorbed by the water in the boiler.

You Can Learn About Furnaces From Skyscrapers

Considerable can be learned about correct heat enclosure construction from a study of skyscrapers. Perhaps you have never thought about the similarities between these two kinds of structures utilized for entirely different services, but it's true. Which again illustrates the fact that a few fundamental principles, when properly applied, can solve many engineering problems.

Tall buildings were originally built using all-masonry construction. As the height of the building increased, the thickness of the walls in the lower portions of the building had to be made greater to carry the additional load of the upper stories. A point was soon reached when it was no longer possible to add height to the building because of the excessive wall and foundation thickness required in the basement and lower stories of the structure.

Architects and structural designers, appreciating the limitations of the solid masonry construction, began searching for means to reduce the weight of buildings so that they could be increased in height.

In 1883, Jenny designed a building 150 ft high that departed radically from the then conventional all-masonry construction. His design incor-

porated cast-iron columns in the brick walls to carry the building load and thereby reduce the wall thickness. Such a departure in the then conventional and time-proven construction immediately caused many to question the advisability of the construction. What about expansion? A metal column 150 ft long subjected to a change in temperature of 120 F between winter and summer would vary in length. Expansion immediately became of considerable importance—although the former all-masonry construction did expand and contract. Expansion was accommodated in this combined metal and masonry construction by carrying the structure floor by floor on the columns thereby allowing each story to expand and contract independently.

This construction was a radical departure, and as a consequence, many were skeptical about its reliability. At the time the original portion of the Monadnock Building in Chicago, the Home Office of POWER PLANT ENGINEERING, was designed, the architect wanted to employ the then new construction developed by Jenny, and others. The owners, over the protests of the architect, insisted that the building be solid masonry construction. As a result of this demand of the owner, the walls at the street level (which are not strictly walls, but supporting piers) were 6 ft to 8 ft thick for a structure 16 stories in height. A few years after the original portion of the building was completed, an addition was made on the south half of the block having 17 stories. When the addition was made, the owners permitted the use of the true skyscraper construction which had been rejected for the original portion. The difference in window areas and wall thickness at the street level which to some extent were effected by later construction is apparent.

Today our skyscrapers are raising their heads over 1200 ft above the street level, because through the years structural designers have learned how to design frameworks that can carry the weight of the building and its contents thereby permitting relatively light-weight walls to be used. These walls, supported by the framework, provide flexibility in the structure to compensate for expansion and movement due to wind pressure or earthquake shock.

Evolution of Boiler Heat Enclosures

Boiler heat-enclosure development has gone through a similar evolutionary period. The original method of construction was to fabricate a solid masonry wall comparable to the now obsolete skyscraper construction. Instead of being subjected to temperature variations of 120 F, the boiler furnace had to withstand the expansion resulting from temperature variations as great as 2500 F. As boilers became larger and larger, heat enclosures were made higher and higher to provide sufficient volume for combustion of the fuel. And as the wall height increased, the expansion problem multiplied. Failures were all too frequent, and service from solid-masonry heat enclosures was poor indeed.

Increased height meant that thicker walls were required to provide the necessary wall stability. And thicker, taller walls were heavier, resulting in greater foundation loading. Soil bearing became a problem since space for distributing the load resulting from this solid masonry construction on large boilers was not always readily obtainable.

Many boilers provided with shallow ash pits and having solid masonry walls developed uneven settlement because the heat transmitted into the soil beneath the ash pit dried out the soil. This drying in numerous instances extended from 10 to 15 ft below the bottom of the ash pit. And as the soil dried it settled, resulting in uneven movement of the wall above and subsequent foundation failures and wall cracking.

In order to increase the reliability of the heat enclosure, it became necessary to parallel the development in skyscraper construction by providing a framework for supporting the heat-enclosing refractories. Expansion joints, both horizontal and vertical were needed to absorb the variations in refractory size due to temperature changes to which it was subjected. Supporting the heat-enclosing refractory from a properly-designed steel framework allowed the heat-enclosure designer to proportion refractories and insulation backing for the temperature conditions encountered, thereby eliminating much unnecessary masonry work and decreasing the weight of the heat enclosure. This produced a lighter-weight flexible structure capable of accommodating itself to any boiler shape or size.

Sectionally Supported Wall

The ability to decrease the weight of a boiler heat enclosure through the use of sectionally-supported construction was strikingly demonstrated at the Homan Avenue boiler plant of Sears, Roebuck & Co. in Chicago some years ago. The boiler house had been so designed that the boilers were supported by the building steel framework. The original boilers were 5000-sq-ft long-drum, straight-tube units, set two boilers in battery, and equipped with solid masonry heat enclosures having side walls 22½-in. and a rear wall 18-in. thick.

It was decided to replace each battery setting of two boilers with a single boiler of 11,650 sq ft heating surface, and raise the boilers in order to obtain sufficient furnace volume, for the complete burning of coal with a spreader stoker. This raising operation required heat enclosure walls over twice the height of the original solid masonry walls.

Each new boiler was installed in the space formerly occupied by two boilers, and the boiler height increased as required. The weight of the heat enclosure used was actually less than the weight of the old solid-masonry setting. This was brought about through the use of Reintjes sectionally-supported wall constructions. Where the solid-masonry wide walls weighed 238 lb per sq ft, the new 9-in. sectionally supported construction weighed only 118 lb per sq ft. On the rear wall, the original installation, using 18-in. solid masonry construction, weighed 190 lb sq ft while the modernized installation used a 4½-in. sectionally-supported construction weighing only 45 lbs per sq ft. As a result of this reduction in weight, no modifications were necessary in the building steel framework to support the larger boilers.

Thus the sectionally-supported heat enclosure came into being because the solid-masonry heat enclosure, like the solid-masonry building, couldn't keep pace with modern requirements. It came because of the need for controlling the expension and contraction of the refractory subjected to widely varying temperatures. And controlled expansion ensured long-lived, reliable heat enclosures for the modern boilers.

For a Broader Viewpoint

I HAVE BEEN wanting to take the time to express my appreciation of finding an engineering publication that dares (if I may use the word) to tell the engineers and management that they have to broaden their views when it comes to the world of people and of things. Through my engineering contacts I have discovered that even a half-way liberal outlook might brand one as "communistic." In a way I have been very disappointed with my chosen profession and wondered if I was becoming a misfit. Your magazine has made me realize that others also are beginning to look ahead. Hence, I thought it was about time that I let you know that at least one person is reading and thinking over your statements in the editorial pages of POWER PLANT ENGINEERING. I sincerely hope that there are many more that are doing the same, not because I am afraid to stand up for my convictions but for the promise this broader viewpoint holds for the future of America.

Just so that you may give this correspondence its proper weight, I will admit that I am new in the engineering field, having been graduated from the University of Illinois with a B.S. in M.E. in January, 1943. I am now working as a field engineer with a large electric manufacturing company. Keep up the good work.

HARRY O. GERSTUNG

What the Power Engineer Should Know About

THE SLIDE RULE

Part III. By DENARD LEE GUSLER

PERHAPS a practical problem, involving vectors and some of what we have discussed so far, would be interesting. Fig. 2 illustrates about as simple an electrical circuit as you will ordinarily find. Yes, it is simple all right but can you work it? Before going further, copy it down and try working it the hard way. We want to know the current in each branch (I_1 and I_2), total current (It), true power, apparent power, and power factor.

By slide rule, the problem is solved, easily as follows:

The reactance of L is found by the formula

$X1 = 2\pi fL = 2 \times 3.1416 \times 60 \times 0.133 = ?$

Set left index of C opposite 2 on D.

Move hair line to 3.1416 on C.

Move right index of C under hair line.

Move hair line to 6 on C.

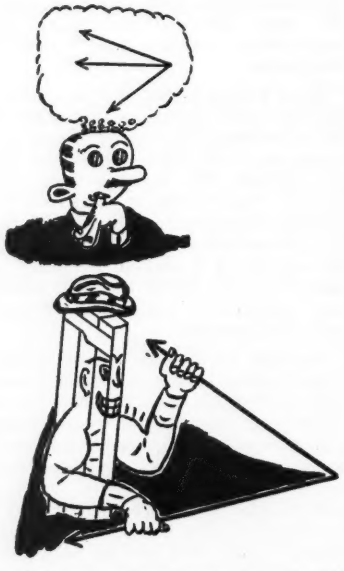
Move left index of C under hair line.

Shift hair line to 0.133 on C. Under hair line on D read answer 50 approx.

$X_L = 50$ ohms which is the inductive reactance.

The reactance of C is found by the formula $X_c = \frac{1}{2\pi fc}$

For convenience $2 \times 3.1416 = 6.28$ and $\frac{1}{6.28}$ is always 0.1592. It is another time saving point to remember



Don't let vectors perplex you, let your slide rule handle them

$$X_c = \frac{0.1592}{60 \times 88.4 \times 10^{-6}} = \frac{159.2 \times 10^{-3}}{6 \times 8.84 \times 10^{-4}} = 3 \times 10^1 = 30$$

Set hair line to 159.2 on D.

Move 6 on C under hair line.

Move hair line to right index of C.

Move 8.84 on C under hair line.

Opposite right index of C read answer 30 on D.

$X_c = 30$ ohms which is the capacitive reactance.

In branch A we have 75 ohms of resistance and 30 ohms of capacitive reactance. Putting it in the rectangular form to solve for total impedence we have $Z_a = 75 - j30$. We show this condition by the vectors in Fig. 3.

In this diagram, the resistance R (75 ohms) is drawn to scale horizontally. The capacitive reactance X_c (30 ohms) is labeled j-30 and is drawn to scale at right angles to the line representing the resistance. The total impedence Za is the resultant or vector sum of the resistance and the reactance. The value of Za may be obtained graphically as in the diagram, or it may be calculated. From the laws of triangles we know that the square on the hypotenuse is equal to the sum of the squares on the two sides. That is

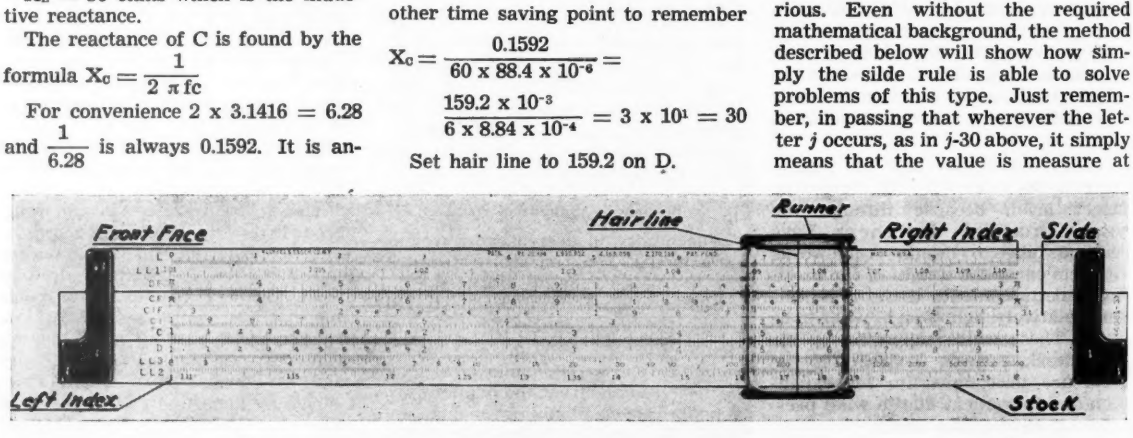
$$Za^2 = R^2 + X_c^2$$

$$\text{or } Za = \sqrt{R^2 + Z_c^2}$$

$$\text{In this case } Za = \sqrt{75^2 + 30^2}$$

$$= \sqrt{5600 + 900} = \sqrt{6500} = 80.8$$

The slide rule, however, enables us to arrive at this result in a much more direct manner. The method, however, involves a knowledge of rectangular and polar co-ordinates, and while this is simple enough, those who are not familiar with it, may find the following somewhat mysterious. Even without the required mathematical background, the method described below will show how simply the silde rule is able to solve problems of this type. Just remember, in passing that wherever the letter j occurs, as in j-30 above, it simply means that the value is measure at



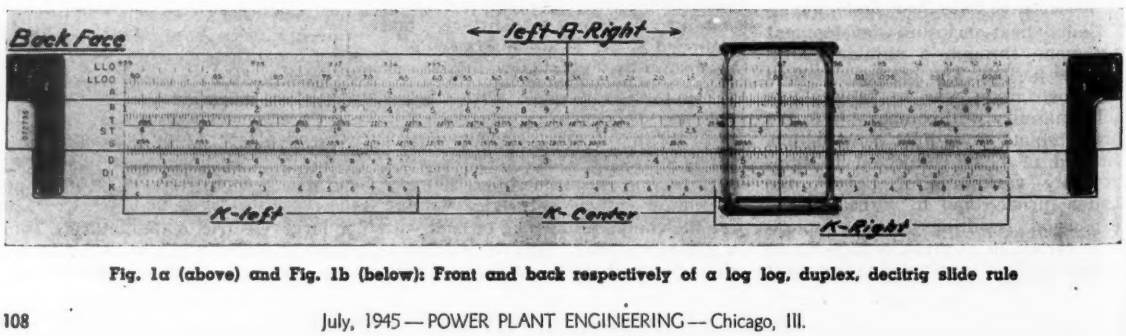


Fig. 1a (above) and Fig. 1b (below): Front and back respectively of a log log, duplex, decitrig slide rule

right angles to the line representing resistance.

Using the slide rule to convert from the rectangular to polar form:

Set the right index of 5 to 75 on D. Set hair line to 30 on D. Under the hair line on T read the angle 21.8° in black figures. We knew the angle would be less than 45° because the R factor was larger than the *j* factor. Leaving the hair line set we slide the black 21.8° on S under the hair line and opposite the right index of sine read Za which is 80.8 ohms. This means that the generator at point A is looking into an impedance of 80.8 ohms at an angle of —21.8°.

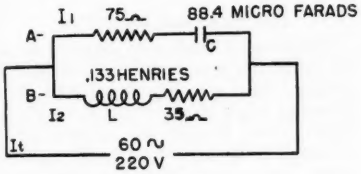


Fig. 2

The electrical condition of branch B is shown by the vectors in Fig. 4, which means that Z6 = 35 + *j*50. Set the right index of S to 50 on D and the hair line to 35 on D. Under the hair line we read the red angle 55° on T which we knew would be larger than 45° because the *j* factor was larger than the R factor. Leaving the hair line set, slide the red 55 on scale S under the hair line. Opposite the right index of S on D we read the answer 61. This means that the generator at point B is looking into an impedance of 61 ohms at an angle of +55°.

Closing the rule and setting the hair line on red 55° on scale S we find under the hair line on D the number 57.3 which is the cosine of 55° and tells us the power factor in branch B is 57.3 and is lagging.

To find current in Branch A set the hair line on 220 scale D and move 80.8 on scale C under the hair line. Opposite right index of C on D read 2.72.

$$Ia = \frac{220 \angle 0°}{80.8 \angle -21.8°}$$

$$= 2.72 \text{ amp} \angle 21.8°$$

Which means the current here is leading 21.8°.

To obtain current in branch B. Team hair line set on 220 D. Move 61 on C under hair line. Opposite right index of C read 3.6.

$$Ib = \frac{220 \angle 0°}{3.6 \angle 55°} = 3.6 \angle -55°$$

Which means the current here is lagging the voltage 55°.

To divide the currents Ia and Ib into their vector components so that they can be added we proceed as follows:

2.72 x Sin 21.8° = *j*
Set right index of S on 2.72 on D.
Move hair line to black 21.8° on S.
Under hair line read 1.01 on D.

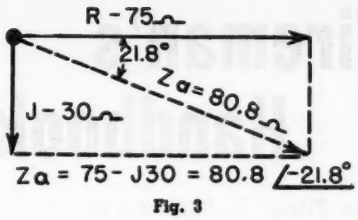


Fig. 3

j factor is 1.01.
2.72 x Cos 21.8° = R.
Leave index set on 2.72.
Move hair line to red 21.8° on S.
Under hair line read 2.52 on D.
Ia = 2.72 ∠ 21.8° = 2.52 + *j* 1.01.
3.6 x Sin 55° = *j*
Set right index of S on 3.6 on D.
Move hair line to black 55° on S.
Under hair line read 2.95 on D.
j factor is 2.95.
Leave index on 3.6.
Move hair line to red 55° on S.
Under hair line on D read 2.06.

Ib = 3.6 ∠ —55° = 2.06 — *j* 2.95

Adding 2.52 + *j* 1.01
2.06 — *j* 2.95
4.58 — *j* 1.94

To convert the above from rectangular to polar form.

Set the right index of S on 4.60 on D and the hair line on 1.95 on D.

Under the hair line on T we read the black angle 23° which we knew would be less than 45° because the R is larger than the *j* factor. Leaving the hair line set move black 23° on S under the hair line. Opposite the right index of S on D we read 5.

Thus 4.58 — *j* 1.94 = 5 ∠ —23° (amps).

Dividing the total current into generator voltage to obtain total impedance we have:

$$\frac{220 \angle 0°}{5 \angle -23°} = 44 \text{ ohms} \angle 23°$$

Power factor is equal to cosine of angle of lag or lead.

Cos 23° is found by setting hair line to red 23° on S. Under the hair line on D read 92.

Power factor of circuit = 92 per cent lagging. Apparent power = E x I = 220 x 5 = 1110 watts. True power = E x I x PF = 220 x 5 x 0.92 = 1010 watts.

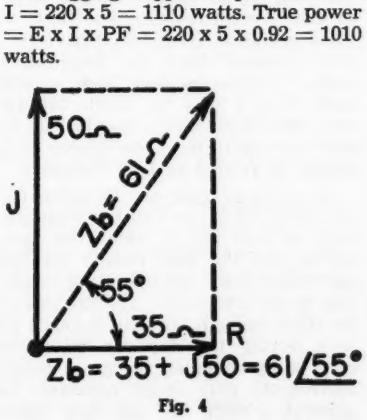


Fig. 4

That's all there is to it.

It was not intended here, to present a complete slide rule course. Rather an effort was made to present a general idea of its construction and some fundamental applications by working out practical problems.

If I seem a bit over enthusiastic in my attitude towards the slide rule it can be attributed to the fact that I have found it an unusually valuable instrument and that the more I use it the more I seem to learn from it. When a person undertakes to learn a foreign language, he is usually astonished to find out how little he knows about English. When you undertake to learn the slide rule you may run into a similar situation with regard to your knowledge of mathematics and in that way will serve in a dual capacity—in introducing a new subject it compels you to review an old one.

Note: This is the concluding article of a series of three on the slide rule by Mr. Gusler. The first two appeared in the May and June issues respectively.

The Slide Rule—Correction

CAPTAIN CHARLES MORGAN of the Army Service Forces at Fort Monmouth, N. J., has called our attention to a typographical error in the first part of Mr. Gusler's article on The Slide Rule which appeared in the May issue. The error was the printer's, not the author's, and while it seems minor it is likely to lead the reader astray if he is not familiar with slide rule operation.

On Page 110, in the second example, of division, where 975 is divided by .0023, the terminal indicator for the divisor should be written as 2.3×10^{-3} rather than 2.3×10^{3}. By writing it in this manner it is seen that when you subtract a —3 exponent from a plus 2 exponent, the resulting exponent is 5, as shown in the article.

We regret our carelessness in letting this error go through and are grateful to Captain Morgan for directing our attention to it.—Editor.

Capacitor Motors

THE CAPACITOR MOTOR was first developed to provide a quiet operating fractional horsepower motor for driving oil burners, pumps, refrigerating compressors, and similar equipment requiring high starting torques, long annual runs, and high power factor and efficiency.

Motors of this type are made with condensers mounted internally and externally. The external type of mounting is favored especially with smaller units. Capacitor motors are now available in sizes up to 10 hp, but the condenser unit increases the forst cost materially over repulsion-induction or squirrel cage machines.

The Boiler Fireman's Handbook

By J. R. DARNELL

Forced draft traveling grate firing. . . . Starting a fire. . . . Fuel bed thickness. . . . Fuel sizing and distribution. . . . Tempering coal by adding moisture. . . . Draft and air distribution. . . . Speed control.

Part XII—Stoker Firing Methods

STOKERS may be divided into two main divisions and these into their respective sub-divisions as follows:

1. Over-feed.
   - A. Horizontal moving bars.
     - a. Forced draft traveling grates.
     - b. Natural draft chain grates.
   - B. Inclined rocking bars.
     - a. Hand operated.
     - b. Power operated.
   - C. Horizontal stationary bars—rotary spreader.
2. Under-feed.
   - A. Single retort.
   - B. Multi retorts.

Forced Draft Traveling Grate Firing

Either chain or traveling grates are generally adapted for coals having high ash with low fusion point since there is no agitation or disturbance of the fuel bed and consequently clinker formation is reduced to a minimum. These stokers may be used advantageously with a wide variety of solid fuels, particularly if forced draft is used. Such stokers can be used with bituminous and anthracite coals, lignite, coke breeze, and wood chips. Since the furnace design will vary with the particular type of fuel used, we will try to enumerate certain general instructions to be observed for each type of fuel.

Starting a Fire

The following method of starting a fire may be used with either natural or forced draft although with some fuel bed should be somewhat less with natural draft. Set the feed-gate to give a fuel bed thickness of 4 to 5 in. and then run green coal onto the grate for a distance of about 4 ft. Next, through the side doors, throw in wood and oily waste or rags on top of the coal. Ignite this material with the stack damper and air valves slightly open and without forced draft. As the coal becomes thoroughly ignited, the natural draft should be increased by gradually opening the stack damper and air valves. Now, start the stoker at the lowest speed and gradually apply forced blast. Before starting the fan, close the air valves in each compartment and then open them only as the fire progresses over the corresponding air zone. Care must be used at this point or too much air will dull the fire and retard combusion.

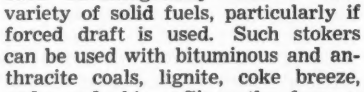


Fig. 1. Round spouts discharging above the level of the fuel hopper cause segregation of coarse and fine particles

Mid-western coals — Illinois, Indiana and western Kentucky—ignite more readily than Ohio, Pittsburgh and Eastern coals, such as Pocahontas, New River and Georges Creek. Low grade bituminous coals of Colorado and Iowa and the Western lignites will not ignite at all at the front of the stoker, because of the large percentage of moisture which must first be driven off. Anthracite ignites more slowly than bituminous coal and additional time must be allowed for the fire to work down through the fuel bed before applying forced blast. Coke breeze, unless containing an unusual amount of volatile matter—6 to 8 per cent—will not ignite in a cold furnace and the refractories must first be heated with a coal fire.

Fuel Bed Thickness

Fine grades of anthracite are usually burned with greatest success on traveling grate stokers but, because of their greater resistance to air flow, these grades of coal should have fuel beds thinner than for bituminous coals. Anthracite fuel beds should vary from 4 to 6 in., while bituminous coals may have a fuel bed thickness of 6 to 10 in. Coke breeze beds should be from 5 to 7 in. thickness.

No absolute rule can be given for the thickness of the fuel bed with any kind of fuel but it should be such as to give the best results for the particular load and operating condition of the boiler unit. The fire should be thick enough so that changes of load during the day can be taken care of by changing the grate speed, leaving the gate height constant. In general, a thick fire and slow speed give better results than a thin fire and high speed.

With light loads, a short fire should be maintained. It is not necessary to cover the entire grate surface as with a natural draft stoker. The speed and depth of fuel bed can be adjusted to allow the fuel bed to burn out before reaching the end of the stoker. In this case, no air at all is supplied to the rear part of the stoker, which simply conveys the ash to the pit. This applies to all bituminous coals, lignite and coke breeze. With anthracite, however, the fire should be kept long so as to do as much of the burning as possible under the rear arch.

Fuel Sizing and Distribution

Bituminous coals and lignites used on traveling grate stokers should be crushed to a size where all will pass through a 1¼ in. round mesh screen. With coke breeze all should pass through a ¾ in. round mesh screen, with not more than 2 per cent through a 3/16 in. round mesh screen.

Small sizes of anthracite are, of course, governed by the standard specifications for the particular grade used.

Fig. 2. Flattened spouts discharging below the level of the fuel hopper prevent segregation

Precaution must be taken to obtain uniformity of coal on the grate. With 1¼ in. screenings, the largest lumps will be of this size, while most of it is generally of particles no larger than ½ in. diameter.

Care must, therefore, be taken in the method in which the fuel is fed to the stoker hopper. If it is allowed to avalanche out of a round spout or spouts suspended above the hopper, the fuel will probably form in peaked up piles with the larger lumps thrown to the outside and the fine material in the center. This will cause a distinct segregation of fuel particles in the fuel bed. This is one of the most important points in the successful operation of chain or traveling grate stoker operations. A number of plants have experienced this difficulty, which not only affected combustion conditions but gave rise to other troubles. In one case, the fuel was fed to the hopper through three round spouts with the ends flared in bell shape, as shown in Fig. 1.

This segregation of fuel particles caused two distinct streaks or grooves down the center of the fuel bed and also a streak along each side. The streaks or strips along the side in which the fuel was burned down near to the grate were not so noticeable

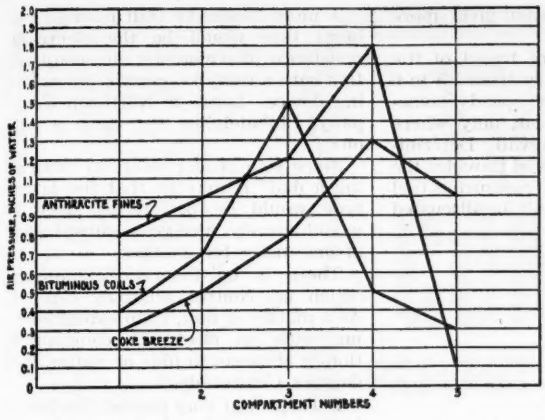


Fig. 3. These curves show representative air pressures for a 5-compartment stoker when burning either bituminous coal, anthracite fines or coke breeze

as those in the center, since combustion in the fuel bed is usually more complete along the sides than in the center. This is due to greater air leakage and more rapid burning. The grooves in the fuel bed on either side of the center spout were distinctly noticeable but operators did not realize what was causing them nor did they connect the cause of these grooves with another and even more serious difficulty—that of arch erosion.

Air naturally follows the lines of least resistance and will accordingly pass through the fuel bed along points where the fuel particles are coarsest. This obviously causes a greater evolution of gas along the strips of coarse fuel. So much gas is generated above these narrow strips that complete combustion of much of this gas is not effected until it strikes the arch. This causes higher temperatures just above the strips of coarse fuel than at other points, with a resulting softening of the arch. With these longitudinal strips of the arch softened by the high temperature and a greater density of gas along these lines it is quite easy to see what would cause distinct grooving or erosion of the arch as the gases sweep around the end.

Remedy for this trouble was quite simple and it was only necessary to alter the method of supplying fuel to the hopper. This was done by removing the round, bell-shaped flares on the ends of the spouts and substituting sections which were flattened out as shown in Fig. 2, allowing more fine particles to be dropped across the width of the stoker. In addition, the sides of the fuel hopper were extended above the old level, so that the ends of the spouts would be covered at all times, if the hopper and the spouts were kept filled all the way up to the bunker above. In this way, the larger lumps did not roll to the outside and there was no distinct segregation.

After the fuel spouts were changed, a marked improvement was noted all around. There was less carbon in the ash, a better quality of furnace gas and no appreciable erosion of the arch.

Segregation may also be eliminated by swinging spouts, either hand or automatically operated, or by installing a screw type of spreader.

Tempering Coal by Adding Moisture

Supplementing our general discussion of this topic in Chapter VI, Eastern bituminous coals, such as Pocahontas, New River, Clearfield and Georges Creek, as ordinarily received, contain too little moisture to be burned properly on traveling grate stokers. Consequently, it is necessary to temper these coals by adding moisture to such extent that they will contain 6 to 8 per cent. Unless this is done, these coals will puff up into hard cauliflower-like formations, which make it impossible to obtain a uniform flow of air through the fuel bed. Pittsburgh and certain Ohio coals are also somewhat of the same nature and must be tempered to contain about 8 to 10 per cent moisture.

Mid-western coals, being free-burning and non-caking, require less tempering, particularly since, as ordinarily received, they already contain 8 to 10 per cent moisture. Where these coals are somewhat dry, however, and there is an excess of fine material, traveling grate stoker operation is improved by slight tempering. Adding water is particularly advantageous in preventing sifting of small particles.

Tempering is best accomplished by wetting the coal at the crusher, or as it is being put into the crusher. This gives the water more time to mix intimately with the coal. If this cannot be done, it may be effected by forcing exhaust (not live) steam through the coal in the stoker hopper.

Draft and Air Distribution

Under all load conditions and with all fuels, only a slight draft or negative pressure should be maintained in the furnace. This should average from 0.03 to 0.08 in. of water. With coke breeze and small sizes of anthracite it is particularly important to keep this draft as close to zero as possible. With coke breeze, having an exceptionally small amount of volatile matter, it is sometimes necessary to operate for a short period with a positive pressure of 0.01 to 0.02 in. of water in the furnace. This should be done, if ignition is being lost and the fire is not burning to within at least 18 in. of the feed-gate. If the fire starts to burn away from the feed-gate, the stoker should be slowed down or even stopped for a short time.

With forced-draft stokers, the air distribution in the various compartments must be governed by the kind of fuel used and the length of the fuel bed.

Burning bituminous coals with moderate moisture content does not present much difficulty. The amount of air in each compartment depends somewhat on the particular make of stoker used, the number of compartments in the stoker, the ash content of the coal, and whether or not there is a rear arch and how far forward this arch extends. In general, in a five-compartment stoker, air distribution may be as shown in Fig. 3. If there are more or less compartments, air distribution should be governed proportionately. Bituminous coals with high moisture and lignites should have no air supplies to the first compartment and only a little to the second, as moisture must be driven off before ignition takes place. Air applied at this point chills the fuel and retards ignition. In other respects, air distribution should be the same as with other bituminous coals.

In addition to the need of higher pressure to overcome the increased resistance, fine sizes of anthracite require different air distribution. These fuels are slower to ignite and the air pressure should be highest near the rear of the stoker. With No. 3 and No. 4 buckwheat, the rear arch should extend forward far enough to cover completely the last two zones and air pressure should not be sufficient to blow coal particles off the grate except under this arch where they can be deflected back onto the grate. Air distribution for this fuel, in general, is likewise shown in Fig. 3.

As with anthracite, coke breeze is slow to ignite, especially if wet, and the general shape of the air distribution curve is the same. Being much more porous, however, lower pressures may be used than with anthracite. The general shape of the curve is also shown in Fig. 3.

It should be noted that with any kind of fuel and with all makes of traveling grate stokers, air pressures in the various compartments should be raised or lowered together, depending upon the combustion rate.

Speed Control

Flexibility of speed control is one of the most important points in the successful operation of this type of stoker. It may be driven either by a

ratchet wheel and pawl, or by a worm gear. The former, found on older types, gives an intermittent jerky movement to the grate while the latter provides smoothly continuous travel.

With the worm gear drive the best sources of power are a direct-connected steam engine or an electric motor. With electric power, either alternating or direct current may be used, although the latter gives more flexibility of control.

The average rate of travel of the grate surface may vary from 1.5 to 6 in. per min. Higher speeds sometimes are employed but only where unusual conditions prevail. Determination of the grate speed provides the basis for a method of measuring fuel consumption. This will be discussed in the next chapter.

LETTERS AND COMMENTS

Theoretical Air for Combustion

The practical engineer trying to progress comes upon some problems that are somewhat confusing. For the most part they are not college men and it, therefore, requires long study on some matters and then they are not always clear.

I am presenting, here, one problem which puzzled me, viz., the air theoretically required for combustion. After studying various books such as Babcock and Wilcox Boiler Book, "Steam" and Heinie Boiler Book, "Steam Boiler Engineering," I was able to figure out the meaning of the formulas, etc.

I submit this in hope it may help some other engineer without a degree to understand the meaning of this problem.

Theoretical Air for Combustion

In order to supply one pound of oxygen for combustion, it is necessary to supply 4.319 pounds of air. The question may arise as to where the figure 4.319 is obtained. Since the percentage of oxygen in air is by weight 0.2315 per cent, $1 \div 0.231 = 4.319$ or as most commonly used 4.32 lb. The figure 4.32 may be at times given or 4.33 and 0.231 as 0.232 but the final results are nearly the same.

The ratio of carbon to oxygen in CO_2 is 1 to 2.667. As most books fail to give the source of these figures, let us see where we get 2.667.

It will be noted that one atom of carbon unites with two atoms of oxygen to form CO_2 or Carbon Dioxide.

The atomic weight of carbon is 12, and oxygen 16. We have in O one atom of oxygen and in O_2 two atoms. Then since one atom by weight is 16, O_2 being twice as much its value would be 32. Then C plus $O_2 = CO_2$ which in turn is, 12 plus $(2 \times 16) = 12$ plus $32 = 44$. This is the union of 12 parts of carbon by weight and 32 parts of oxygen by weight.

If we consider one pound of carbon as being burned, the oxygen necessary for combustion is $32 \div 12 = 2.667$ pounds.

NOTE: This is oxygen for combustion and not air. In order to supply one pound of oxygen there must be $2.667 \times 4.32 = 11.52$ pounds of air supplied.

CHESTER V. EMERSON,
Chief Engineer,
Old Colony Laundry
Inc., Quincy, Mass.

An Answer to the Refrigerator Temperature Control Question

Unless your reader's problem involving a warning signal in his refrigeration plant is an intricate one, I should think that a thermostat in series with a light or bell would be the answer. I have in mind one made by the Fenwal Company, Ashland, Mass., which is in cartridge form. This unit can be easily installed in the refrigerant pipe line by drilling and tapping a hole for this purpose. The refrigerant then flows around the unit. Another installation of the same type could be in the freezing chamber.

A more expensive (but perhaps the best) type would be the electrical resistance thermometer in conjunction with a relay to operate the warning device. Leeds & Northrup Company, Philadelphia, Pa., have a fine one.

Since your reader refers to "watching a dial" it may be that the latter type would be preferable, since it would merely involve a substitution of one meter for another.

There is no theoretical limit to which his control accuracy can go. As a matter of fact, I am experimenting with an electronic contraption that is accurate to plus or minus .003 degrees Centigrade.

Perhaps you may publish his problem in greater detail. I would be interested in knowing more about it. Marblehead, Mass. LEWIS H. PHILLIPS

Another Answer to the Over-temperature Alarm Question

THE PROBLEM referred to in the April issue, page 93, having to do with a hotel refrigerating plant, is not given in sufficient detail to permit of a complete analysis, however the following outline of methods commonly used for controlling temperatures in refrigerated rooms may be of some help to the inquirer.

In many installations the evaporator is equipped with a thermal expansion valve which practically closes the supply of refrigerant to the evaporator as the suction gas approaches the saturation temperature and restores the supply as the suction gas becomes superheated. The actuating force which opens and closes this type automatic valve is the change of pressure on the valve diaphragm resulting from the expansion and contraction of the fluid in a flexible tube that is fitted at one end with a bulb which is fastened to the suction pipe near the evaporator suction outlet.

When the suction gas passing the location of the bulb is superheated, the fluid in the bulb expands, exerting a pressure on the diaphragm, causing the valve to open wider and supply more liquid to the evaporator. If too much liquid enters, the superheat disappears and the gas approaches the saturation point which in turn causes the supply of refrigerant to be reduced. The thermostatic valve simply regulates the flow of liquid to the evaporator according to changes in suction gas superheat as it leaves the evaporator.

The superheat in the suction gas leaving the evaporator will vary with load changes, therefore the flow of liquid is regulated according to the load demands at any given time.

A means of positive temperature control is the thermostatically operated magnetic valve placed near the thermostatic expansion valve. Magnetic valves will positively close the liquid supply to the evaporator when the temperature has reached the predetermined point and restore the sup-

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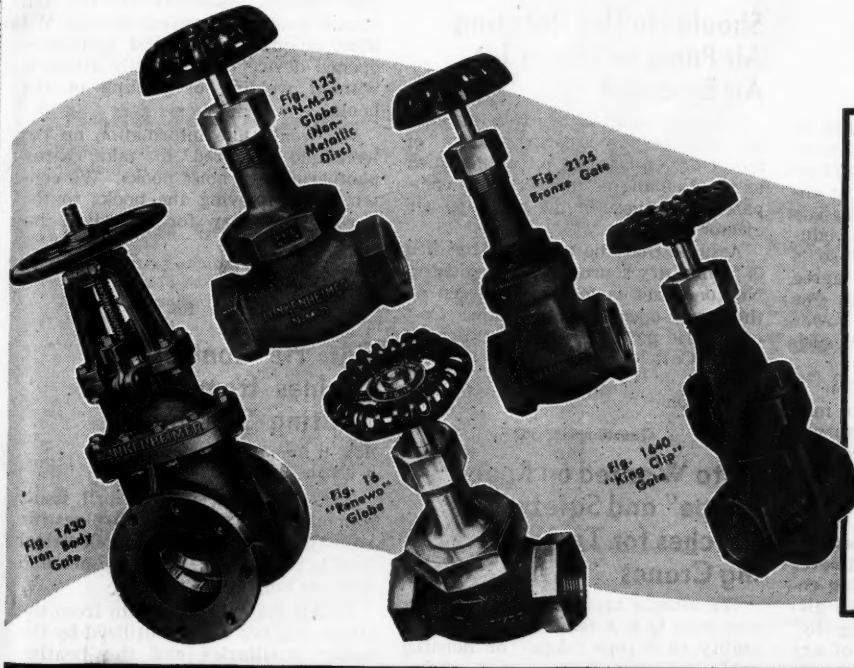
Fig. 123 "N-M-D" Globe (Non-Metallic Disc)
Fig. 2125 Bronze Gate
Fig. 1430 Iron Body Gate
Fig. 16 "Renewo" Globe
Fig. 1440 "King Clip" Gate

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BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S. P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

ply when the room temperature has risen to the allowable upper limit. Magnetic valves, sometimes called solenoid valves, are used equally as successfully for controlling the temperature of water, brine, milk and other liquids.

In rooms where certain commodities are stored that are easily damaged by too low temperatures, as for example eggs and apples, a magnetic valve is placed on the suction outlet and so wired as to close at the same time as the magnetic valve on the liquid supply line, thus bottling up the refrigerant in the evaporator and stopping further cooling. Otherwise, with the compressor still operating, any liquid remaining in the evaporator after the closing of the liquid supply valve would continue to boil off and lower further the room temperature which could easily result in damage to the commodity.

In many modern refrigerating plants the temperature controls are often so connected as to stop the compressor when all refrigerated rooms have been reduced to the desired temperature and to start the compressor when the temperature in first of the refrigerated rooms rises and calls for refrigeration. Later, as each of the remaining rooms call for refrigeration, the automatic valves of each opens and supplies the necessary cooling demands.

Atlanta, Ga. C. T. Baker

Green to Harris on Education vs. Experience

After carefully reading Richard P. Harris' comments in the April issue, I am convinced that he is a college graduate as well as an operating engineer. As I stated in a recent issue of POWER PLANT ENGINEERING, education is vitally necessary but so is practical experience. I do not agree that a man who passes coal a few months is qualified to operate a power plant and I did not make any such assertions in my article.

From Mr. Harris' discussion it would appear that because a man has the financial means to go to college, which many very intelligent men do not have, it gives him a superior mentality. I think that that idea is very much in error.

If I were a college graduate in mechanical engineering I would never waste my talent as an operating engineer. The college man who is giving the high-school lad the "go-by" doesn't always do so because of any superior mental accomplishments. Check the salary! If a college man with his overabundance of knowledge will work for an operator's salary, the employer will naturally hire the college man in preference to an operating man if he is given the choice.

I did not denounce the college man and never will. The point is, that a man who will study and work hard and learn to know his plant and its operating principles should be encouraged rather than ridiculed. There are many good able men with limited education who can figure how to save fuel and operate a plant at a minimum cost to the employer. The employer who puts men in charge who are not qualified are usually men who would fail to furnish proper equipment even to college men.

I believe Mr. Harris could find a great many plants where there is a complete lack of testing equipment and very few CO_2 recorders, draft gages, coal scales, etc. The experienced man does not have to have all of these devices to determine his efficiency. One would gather from Mr. Harris' statement that all non-college men are incompetent. My idea is to give every man a chance—college or no college. When I have spent $3000 or $4000 going to college to learn what I can get from almost any textbooks, in fact, the same books that the college man studies, I will be ready to work for the industry that pays not less than $500 a month. The college graduate issue, as Mr. Harris sees it, would be a nice way to bar all others, no matter what their ability, from advancing or from being promoted. Once a fireman always a fireman, seems to be some engineers' idea. Thank God there are a few broad minded persons who think differently. Many persons who have preached the "dumb fireman" philosophy have frequently been compelled to seek advice from the same dumb fireman.

St. Louis, Mo. WILLIAM R. GREEN

Questions And Answers

Question No. 301

Should He Use Rotating Air Pump or Steam Jet Air Ejectors?

I WOULD LIKE to have Q & A readers discuss the relative merits of motor-driven rotating air pumps such as the Leblanc or the Hytor as compared with those of the steam-jet air ejector type.

Assume that the air to be handled is from a dry source, not a condenser. No condenser is to be considered on the steam-operated air ejector. Cost of electric power, 1 cent per kilowatt hour. Cost of steam, 25 cents per 1000 lb.

Akron, Ohio J. W.

Question No. 302

Data Wanted on Rope "Dope" and Safety Latches for Traveling Cranes

WE SHOULD LIKE to have information from Q & A readers on the availability of a rope "dope" or hoisting cable dressing that is not sticky, heavy bodied, or opaque. We desire a dressing that will penetrate to the hemp center of the cable, is not affected by average room temperature of 85 F; is quite transparent for usual cable inspection; and is non-drying.

Also we need information on a light, yet durable, safety latch for the sheave hook of traveling cranes. We want a spring-closed and manually-opened device that is easily attached without welding or drilling of the hook.

We would like information on the technique required to take X-ray photographs of hoist hooks. We contemplate removing the hooks to the X-ray laboratory for periodical inspections.

Oak Ridge, Tenn. P. C. Z.

Answer No. 293

Can He Control Gas Engines from Steam Heating System?

How It Can Be Done with a Simple Regulator System

THIS PROBLEM, in the April issue, propounded by O. M. W., involves the adjustment of a fluctuating electrical load between two steam engines and two gas engines so that:

1. All the exhaust steam from the steam engines will be utilized by the boiler auxiliaries and the heating system of the buildings.

2. The steam engines can meet increased demands for exhaust steam.

3. The atmospheric relief valve will not vent any exhaust steam.

4. The control of the system will be entirely automatic.

NEW! The EDWARD Intex UNIVALVE*

Newest addition to the Edward steel valve line, the Univalve is a forged steel globe valve for service to 1500 lb at 950 F. Body and bonnet are a single unit, the seat is integral with the body, and the inclined stem design and streamlined flow contours cut pressure drop to from 25% to 50% of that of most forged steel globe valves.

All the distinctive standard features of Edward valve construction are included—oversize knobbed handwheel, extra-deep stuffing box and cooling chamber, re-enforced EValpak molded packing, junk ring EValized for abrasion resistance, centerless ground EValloy stem—with the addition of many new features that make the Edward Univalve the best buy possible for high temperature, high pressure service.

**Integral seat valve with body and bonnet a single unit.*

1 WELDED BONNET

Patented leakproof welded body-bonnet joint, with backseating joint for repacking under pressure, and designed for disassembly if ever necessary.

2 INTEGRAL hard-faced SEAT

A continuous ring of Stellite applied directly to the body, machined in the same set-up with body bore for perfect alignment, and carefully mated to disk for full bearing area.

3 HARD FACED DISK

Heavy layer of ground and lapped Stellite on alloy steel disk.

4 BOLTED GLAND

Easy packing adjustment, with through-bolted, accurately guided gland.

5 BRONZE YOKE BUSHING

Minimizes wear and prevents galling.

6 ONE PIECE, Integral YOKE BONNET

Perfect alignment of working parts.

7 LOW PRESSURE-DROP FLOW

Edward inclined stem globe valve construction eliminates sudden changes of flow, reduces erosion-producing turbulence, and cuts pressure drop to minimum, yet retains desirable characteristic of globe valve tightness.

UNIVALVE SIZE RANGE
1500 lb —950 F
Screwed Ends
Fig. 2220—½", ¾"
Fig. 3220—¾", 1", 1½", 2"
Socket Welding Ends
Fig. 2224—½", ¾"
Fig. 3224—¾", 1", 1½", 2"

EDWARD *Steel* VALVES

The Edward Valve & Manufacturing Co., Inc. • East Chicago, Indiana

The equipment is arranged as shown in O. M. W.'s sketch Fig. 1, which shows that three 200-hp stoker-fired boilers, which have automatic combustion control, supply the 150-psi steam for the plant. The prime movers consist of two Uniflow steam engines, each driving a 150-kw generator, and two gas engines, each driving an electric generator. The larger gas engine, rated at 120-hp, drives an 80-kw generator; the smaller engine, rated at 100-hp, drives a 75-kw generator. The steam engines exhaust at 5-psi into the steam heating system. The steam for the auxiliaries and the feedwater heater is also taken from the 5-psi system. There is, furthermore, a pressure reducing valve between the 150-psi and the 5-psi systems, to furnish low pressure steam from the boilers if the exhaust steam from the engines is insufficient to meet the demands. There is also an atmospheric relief valve on the low pressure system.

The problem states that the electrical load varies over a wide range and that it sometimes fluctuates quite rapidly. As the Uniflow steam engines are now capable of taking care of the fluctuating load, it is apparent that the governors of the steam engines are capable of controlling the energy supplied to the engines so that they can meet the demands of the electrical system.

The problem can be simplified and clarified by assuming that both the steam engines and the gas engines will be started manually by the operator. It will also be assumed that the generators will be paralleled by the operator.

The installation of a Cash Standard Type 100WC Controller is recommended, as shown in Fig. 2. A pipe line should be connected between the bottom of the diaphragm on the controller and the exhaust steam header. Lever-operated, double-ported valves, such as Fisher or McAlear, should be installed in the gas lines to the engines. A by-pass with a globe valve should be installed around the lever valve. This by-pass valve should be set so that the gas engine will carry a minimum load.

The piston rod on the controller should be connected to Sheave A with a flexible wire cable. Another wire cable should be connected from the lever of Valve B, in one gas line, to Valve C, in the other. This wire cable should pass over Sheave A, as shown. Turnbuckles should be installed where necessary so that all unnecessary slack can be removed from the wire cables.

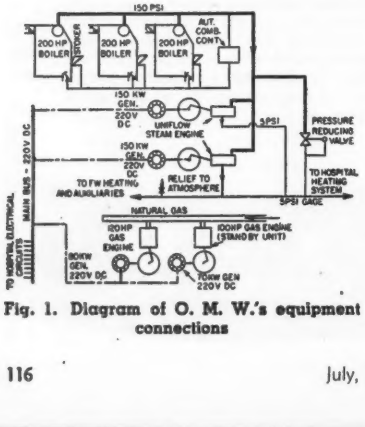

Fig. 1. Diagram of O. M. W.'s equipment connections

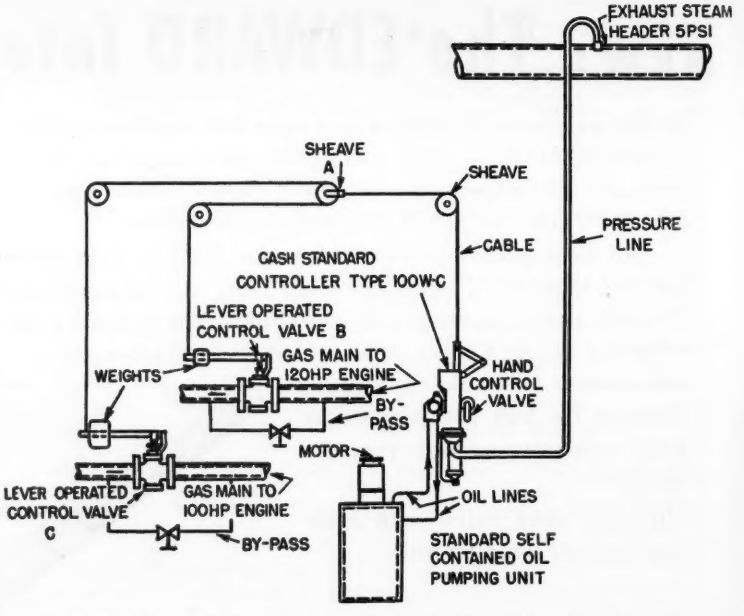

Fig. 2. Schematic diagram by Coscia showing how a standard controller could be connected to control gas engines from steam heating system pressure

A by-pass is installed in each of the gas lines around Valves B and C so that each engine will carry a predetermined minimum load when it is operating. Even though the engine which is controlled by Valve B is not operating, the controller will continue to operate, if less exhaust steam is required, until Valve C is opened and the engine which it controls picks up the load.

The control of the gas engines is based on the fact, that the steam engines, through their governing devices will carry any load within their capacity. In other words, the steam engines will carry any load which the gas engines do not carry. The operation of the controller is based on a change in pressure in the exhaust steam header. The controller can be built sensitive enough to reverse on a pressure change of 0.3 in. water column. Such fine accuracy is not needed on this system, however, and it is recommended that the controller be set for plus or minus 0.25-lb or to maintain a steam pressure between 4.75 and 5.25-psi in the exhaust steam header. The pressure reducing valve between the 150-psi system and the exhaust system should be set for 4.25-psi and the atmospheric relief valve should be set for 5.75-psi.

A cut away section of a Cash Type 100 W Controller is shown in Fig. 3. This is exactly similar to a Type 100 WC controller except that the latter has a hand control valve mounted on it and piped up to it.

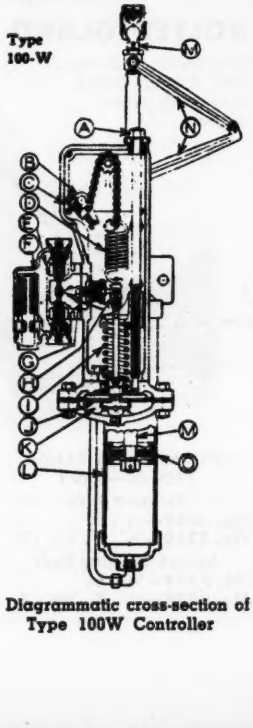

Fig. 3. Diagrammatic cross-section of Cash Type 100W Controller

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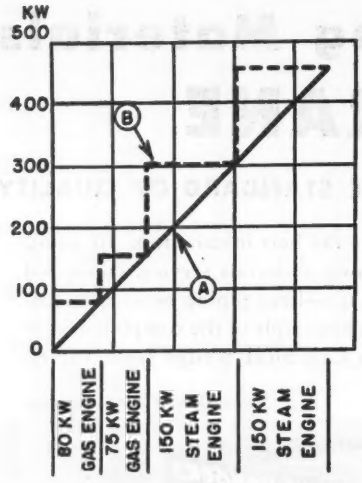

Fig. 4. Curves showing operation of two steam and two gas engines for minimum of exhaust steam demand

Although Fig. 2 shows the controller and lever valves close together, they may be as remote from each other as desired. If there is a failure of any operating part, the levers will close the valves by the force of gravity acting on the weights and reduce the load on the gas engines to a minimum. The steam engines will then pick up the load and during the emergency will exhaust their steam to the atmosphere through the atmospheric relief valve, if there is not any demand for it. As soon as the operator repairs the part which has failed, the control will again function and the gas engines will carry their part of the load as determined by the exhaust steam pressure.

Although Fig. 2 shows an oil pumping unit, the controller may also be operated on water or air at any pressure between 15 and 150 psi. The

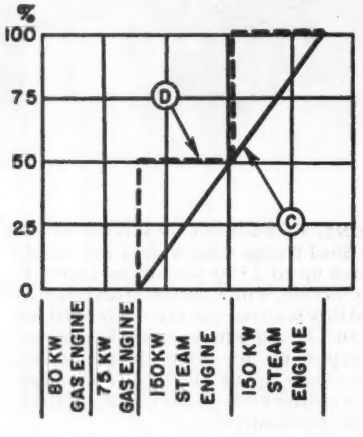

Fig. 5. Exhaust steam available for loads of Fig. 4

pumping unit shown consists of a pump, motor, tank, and automatic constant pressure by-pass valve, which are entirely enclosed in a compact unit.

Fig. 4 Curve (A) shows the sequence of operation for two gas engines and two steam engines when there is a minimum demand for steam. Curve (B) shows the kw available for a fluctuating load.

Fig. 5 Curve (C) shows the exhaust steam in percent of total exhaust steam, available from the loads

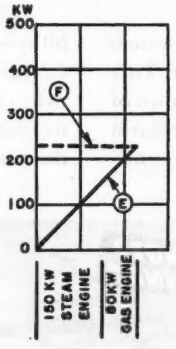

Fig. 6. Curves showing operating sequence for one steam and one gas engine

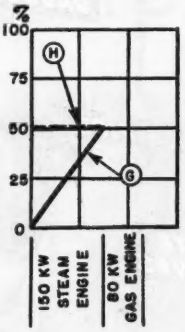

Fig. 7. Exhaust steam available for loads of Fig. 6

plotted in Fig. 4. Curve (D) shows the maimum exhaust steam available from a fluctuating load.

Fig. 6 Curve (E) shows the sequence of operation for one steam engine and one gas engine when there is a maixmum demand for exhaust steam. Curve (F) shows the maximum capacity available in kw for fluctuating loads.

Fig. 7 Curve (G) shows the exhaust steam, in percent of total exhaust steam, available from the loads plotted in Fig. 6. Curve (H) shows the maximum exhaust steam available from a fluctuating load on one steam engine and one gas engine.

The installation of a controller as described is recommended, therefore, because:

1. The electrical load on the generators driven by the gas engines will be controlled so that the load on the steam engines will produce sufficient exhaust steam to maintain a pressure of 5 psi plus or minus 0.25 psi in the exhaust steam header.

2. If the demand for exhaust steam increases, the pressure in the exhaust header will drop. The controller will then reduce the load on the gas engines and the steam engines will pick up the load dropped by the gas engines. A larger load on the steam engines will produce more exhaust steam from the engine and thus increase the pressure in the exhaust header.

3. The quantity of exhaust steam needed to meet the demand of the system will always be furnished by the steam engines.

4. The controller is entirely automatic. After the operator has paralleled the units, the controller will take over and maintain the exact pressure in the exhaust header regardless of the electrical load.

Baltimore, Md. LEWIS G. COSCIA

Kulich Suggests Regulators That Will Do the Job

FROM THE INFORMATION given by O. M. W. regarding conditions in his plant, I would say "Yes, there are such control devices."

One is the Victor regulator, now manufactured by Atlas Valve Co. of Newark, N. J. It will operate on any pressure. I am operating one at present connected to a Todd oil burner on a 200-hp HRT boiler, its operation being entirely automatic.

Another regulator I know of that would do the job on high or low pressure and produce any desired movement is the Type 40-A-T regulator made by Locke Regulator Co., Salem, Mass., but I am not sure this company is in business now.

I am positive regulators of the above type would solve his problem.

Brooklyn, N. Y. STEPHEN KULICH

Editor's Note — There are many regulators of this general type that would be applicable for this service, such as the Atlas, d'Este, Foster, Fisher, Watts, Atwood & Morrill, Davis, A-Jacks, Engineer Co., Illinois, Kieley & Mueller, McAlear and others. A list of manufacturers of pressure regulators will be sent to anyone interested. In addition, most of the manufacturers of automatic combustion controls—such as Askania, Bailey, Brooke, Hagan, Hays, Republic and others—can supply regulators for this and similar service.

Answer No. 294

Why Is Barometric Condenser Water Backing Up?

WHEN H. G. S., in the April issue, asked why water is backing up from his barometric condenser to turbine, he said that the installation worked fine until about 5 months ago, but then the trouble started. He also wanted to know if too much water could be used with a barometric condenser.

The diagram of his turbine and condenser connection, published in the May issue, is repeated here for reference.

H. G. S. has also given us a little more information. He says the unit

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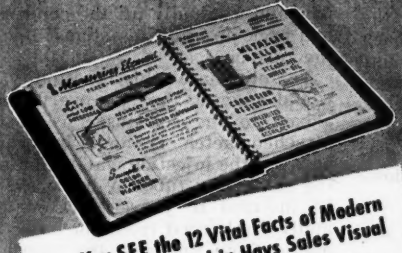

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9. How each individual controller operates.
10. How controllers are calibrated and adjusted to fit requirements.
11. How controllers are stabilized to prevent hunting or over-travel.
12. Typical installations of Automatic Combustion Control.

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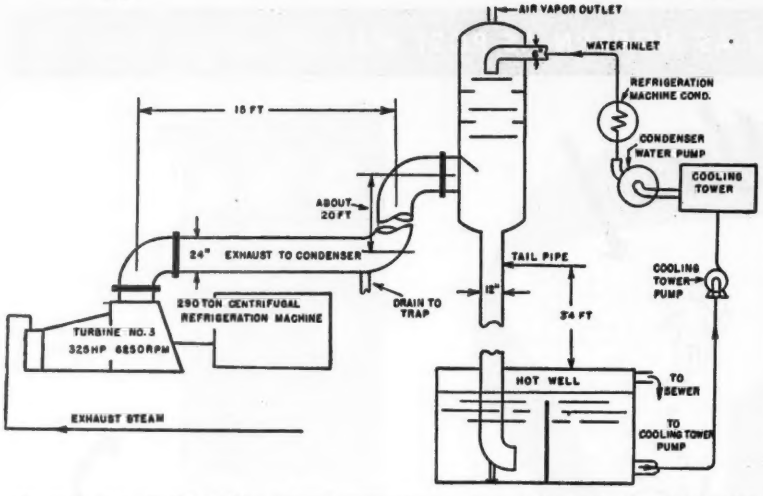

Diagram of H. G. S.'s turbine exhaust connections to barometric condenser, from which he says water is backing up into turbine

is 2 years old and the tail pipe is clean. "So much water is backing up," he says, "that it stops the turbine, and a turbine operating at 6250 rpm cannot stand much of that."

In reply to the question in April, a number of comments were received but we held these pending the publication of the sketch in May, so that the commentators could amplify their comments in the light of the additional data. However, their original comments, before they saw the May sketch, bring out some interesting pointers on barometric condenser operation and we are giving them here for that reason.

For example, George G. Avant, before the diagram was published in May, made the following comment:

Building Up the Vacuum Too Fast

H. G. S. is building up the vacuum too fast when starting up his turbine. This sudden catch in the vacuum causes the water to be pulled over from the tail pipe into the exhaust pipe. This water becomes trapped in the elbow at the bottom of the exhaust and there is no provision for the water to get out.

Several years ago we had trouble similar to H. G. S.'s and we installed a water glass column on the elbow on the exhaust line where the line goes up to the condenser. This glass water column enabled us to see the depth of the water in the exhaust line. We then tried starting up the turbine very slowly, leaving the drain open a long time at the base of the elbow. Then we slowly raised the vacuum on the turbine when the machine was up to speed and no more water was coming out of the drain valve.

After several days of operation we found the water to be rising in the exhaust. We figured that this water was coming from gland leakage (we were sealing the glands with water) and from condensation. We next installed a vacuum steam trap on the exhaust steam line at its lowest point. In order to get the trap below the level of the exhaust line it was placed on a platform in the hot well. The water in the exhaust line flowed to the trap by gravity. When the trap became full of water, the ball body tilted, cutting off the vacuum line and admitting steam to the ball. The steam blew out the water, the empty ball tilted back into place and the vacuum line opened for another charge of water. The trap took care of our trouble. Wilmington, N. C. GEORGE G. AVANT

However, after studying the diagram, Mr. Avant added the following comments:

May Be Water in Steam Supply

AFTER STUDYING the sketch on page 116, May issue, I am of the opinion that there are several things that may be causing the trouble. We will start at the turbine. The sketch shows that exhaust steam is being used. The description says that "so much water is backing up that it stops the turbine." This sounds to me like the excess water is coming into the turbine from the exhaust steam supply. From my experience, when boilers prime, the excess water in the steam will cause the turbine to slow down and it will just about stop if the water is excessive. Also some of the water may be coming from corroded sealing glands on the ends of the turbine shaft.

If the barometric condenser is causing the trouble, there should be some sound like water hammer in the exhaust line. The drain to trap in the sketch causes me to believe that the exhaust to the condenser is above atmospheric pressure and, if not, the trap should be of the vacuum type.

I would suggest to H. G. S. to look about the baffle plates in the top of the condenser as well as the baffle over the end of the turbine exhaust inside the condenser.

From my experience with centrifugal refrigeration compressors, they make a very high demand on the driving unit and if any of the liquid refrigerant comes over, the load is very much heavier on starting.

I am very much interested in the problem and I may be wrong in my suggestions, but we will wait and see all the answers that are published in the June or July issue.

GEORGE G. AVANT

Wilmington, N. C.

In a similar way, E. R. Webber commented on the question in April and amplified his comment after seeing the sketch. Here is his April letter:

How to Install an Overflow to Prevent Flooding

H. G. S. does not intimate whether the injection water is being pumped to the condenser or siphoned from a tank or flume. However, evidently some change took place five months ago that has been causing the trouble. I am inclined to believe that an over-supply of water is being admitted to the condenser through the injection line. If such a condition prevails and water is fed faster than it can pass through the constricted throat area of the combining tube, it would gradually fill the condenser and back up into the exhaust line of the turbine.

To eliminate this possibility, I would suggest that an overflow be affixed to the condenser as in the attached sketch. It should be located between the injection water inlet and the combining tube. A baffle should be inserted to prevent water normally discharged from the injection nozzle from entering the overflow. Only in case of the water level rising above the combining tube should

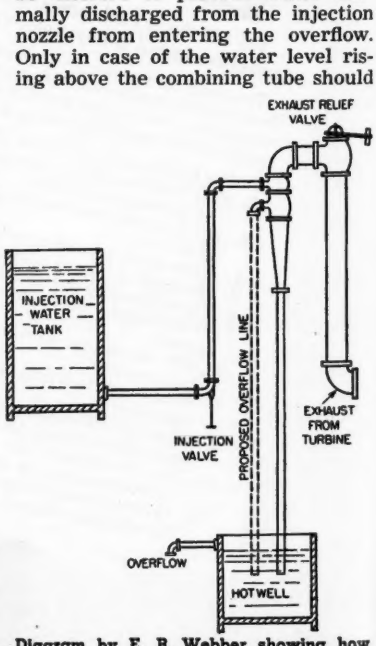

Diagram by E. R. Webber showing how condenser can be equipped with overflow pipe to prevent flooding

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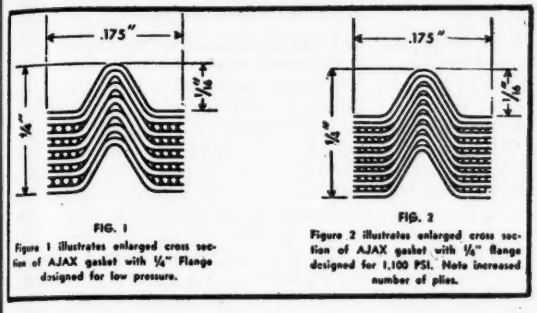

FIG. 1
Figure 1 illustrates enlarged cross section of AJAX gasket with ¼" Flange designed for low pressure.

FIG. 2
Figure 2 illustrates enlarged cross section of AJAX gasket with ⅛" flange designed for 1,100 PSI. Note increased number of plies.

"THE STORY BEHIND THE GASKET THAT BREATHES"

AJAX Gaskets, constructed of one continuous strip of preformed metal wound spirally from the inside to the outside, are engineered to withstand the most severe service conditions in pressure groups to 3500 psi, together with the extreme temperature ranges encountered in superheated steam.

There are twin strips of asbestos filler between each spiral thickness in the AJAX Gasket which cannot meet in the center under the wedge-like groove. Therefore a "breather-space" is preserved in the heart of the gasket which assures its automatic reaction to mechanical compression, to internal pressure variation, and to temperature changes.

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1. Excessive strain on fittings eliminated. Style "A" Gaskets seal under a comparatively low bonding load.
2. Knife edge, interlocked plies of metal between flanges act as automatic expansion member compensating for pressure fluctuations.
3. Higher safety factor, since each gasket is constructed for specific operating conditions.
4. Boiler "outage" time is held to a minimum.
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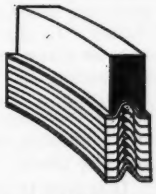

Style S-R Gaskets for Raised Face, Smooth Face, Crane Lap or Van Stone Joints, consist of standard AJAX Spiral Wound Gaskets .175" thick inserted into a solid steel reinforcing ring .125" thick. The reinforcing ring prevents lateral expansion due to compression and acts as a centering device to insure positive location; also as a compression gauge, since the inside diameter of the ring actually rests between the flange bearing surfaces, thereby preventing overloading of the flange studs during installation. Like all other gaskets listed, this style is scientifically designed to seal with a minimum of bolt loading within stress limits for specified bolting arrangements established for fittings in all pressure groups. Gasket and ring are installed as a single unit. Gasket is easily removable for replacement.

AJAX BOILER MANHOLE GASKETS

Style M-H — Three basic pressure groups — 0 to 499 lbs., 500 to 999 lbs. and 1000 lbs. up. Stainless Steel is recommended for use where pressure exceeds 500 lbs. M-H gaskets seal under comparatively low bonding loads. A maximum 1" flange width will accommodate most every service condition encountered in any pressure group. ¼" and ⅛" thicknesses.

Style C-R — The Style C-R Manhole Gasket is self-centering and is in frequent demand for use on boiler manhole plates where chamfer is encountered between the shoulder and the flat of the bearing surface. The centering ring in this assembly is slightly thinner than the gasket itself; assures positive location between two flats. ¼" thickness only.

Style H — Original thickness of gasket is .175" ± .005". Constructed to seal at a compressed thickness of .125" ± .010" with a minimum of bolt loading within stress limits for specified bolting arrangements established for fittings in all pressure groups. Gasket resiliency compensates for stud relaxation, and also for variations in pipe line stresses. The wire guide assures ease of installation and locates the gasket in a positive position.

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water be discharged through this opening. The discharge should be piped to the hotwell and to approximately the same depth as the tailpipe.

The injection valve should thereafter be manipulated so that no water is discharged through the overflow. It should be used only as a safety device to prevent water from entering the turbine by way of the exhaust line.

West Duluth, Minn. E. R. WEBBER

After the May issue appeared, Mr. Webber sent in the following:

Look at Drainage, Water Temperature from Refrigeration Condenser

H. G. S. has enlightened us somewhat by his information and piping sketch in the May issue. But there is still a certain amount of mystery connected with the problem. He does not show the trap connections from the exhaust line. There is a possibility that this water could be backing up through this line. A discharge header common to a number of traps or a receiver connected to more than one drain is always to be eyed with suspicion unless a check valve is placed in each separate drain line. A bypass line around a trap or an inaccessable bleeder line could be causing the trouble.

H. G. S. does not give the temperature of the water being discharged from the refrigeration condenser but the fact remains that the higher this temperature runs the more water that will be required to condense the exhaust steam from the turbine. If more water were being pumped to the barometric condenser than the restricted throat area of the combining tube could take care of, it would of course back up to the turbine.

After perusing the question in the April issue of POWER PLANT ENGINEERING. I submitted an answer and a sketch advising the installation of an overflow on the condenser to prevent this last mentioned possibility. If this condition does exist it would eliminate the trouble I believe.

Providing the equipment operated satisfactorily up until five months ago H.G.S. should try to recollect what changes were made or what circumstance prevailed at about that time to start the trouble.

West Duluth, Minn. E. R. WEBBER

Comments on Flooding, Drainage, Checking Temperatures and Pressures

CAN TOO MUCH WATER be used with a barometric condenser?

Most barometric condensers are designed to operate over a large range of water quantities without flooding. Of course it is possible to put through so much water that it cannot run out without causing flooding but this is not likely in so large a condenser as shown in the sketch.

Is it possible that the water is coming from somewhere else and not backing up from the condenser? Can it be anything like the case described on pp. 48 and 49 of April issue?

Whether H. G. S.' case could be anything like the case described on pages 48 and 49 depends upon where the pipe marked "Drain to trap" is connected. If the discharge end of the drain pipe is under water and the trap is clogged or not operating properly, the water could flow back into the 24 in. exhaust pipe, causing the flooding. In this case the water could be coming from a source other than the barometric condenser.

I do not see how H. G. S. expects to drain water from the 24-in. exhaust pipe since, according to the sketch, this 24-in. pipe is the point of highest vacuum and, as dimensions show, the flow could not be caused by barometric leg since the available distance is approximately 14 ft. However, if this drain pipe is small in diameter (about ½-in.) it is doubtful that enough water to stop a turbine could flow.

Is the refrigerator condenser heating the condensing water too much? Are the pumps operating properly?

Barometric condensers will flood if there is insufficient water to condense the steam or if the inlet water is heated too much. In such a case, either the refrigeration machine condenser or the condenser water pump are at fault. This can be checked by measuring the tail pipe water temperature and the pressure in the condenser. If the saturation temperature as given in the steam tables corresponding to the condenser vacuum is within a degree of the tail pipe water temperature, the condenser is in a condition where flooding is likely to take place.

It is best to measure the condenser vacuum at the flange of the 24-in. vapor inlet using a mercury type U-tube manometer.

It is possible that a leak in the tail pipe has developed. A hole as small as 1/16-in. in diameter could prevent the water from flowing out of the condenser, resulting in flooding. Usually these leaks occur at the pipe flanges.

GEORGE P. CLEMENT, JR.

Harrison, N. J.

Answer No. 296

Should These Turbine-Generators Be Installed or Should Power Be Bought?

IN THE MAY ISSUE, C. F. M. gave data on his plant, which purchases about 136,000 kw-hr a month at $0.016 or 1.6 cents per kw-hr, with a demand charge of $750 a month and generates steam with a coal cost of 21.9 cents per 1000 lb for a building heating load of about 200 bhp.

The present day load is 425-450 kw; night and day loads on Sundays and holidays are about 125 kw.

The management, he says, wants to install two 750-kw turbine generator sets, but he questions the wisdom of this. The exhaust from these units at 5 psi would furnish building heating for 8 mo. of the year but there is no other use for the exhaust steam. No condensing water supply is available. C. F. M. feels it would be uneconomical to operate a 750-kw unit at 450 kw under these conditions. He does not state whether the proposed units are to be new or second-hand. Also no data are given on boiler capacity.

Coal Cost of Generation Too Close to Purchased Power Cost

WITHOUT definite data on the steam pressure available, it is impossible to submit anything but an approximate answer, but with a coal cost of $0.000219 per lb steam and assuming a steam rate of 50 lb per kw-hr, the coal cost of electricity generated would be $0.01095 per kw-hr, which is too close to the purchased rate of $0.016 to allow anything for interest, depreciation, additional labor, etc.

However, in view of the heating load of 200 bhp for eight months per year, the installation of a turbine generator of approximately 150-kw capacity with the use of all the exhaust steam for heating, might be an attractive proposition.

Altoona, Penn. A. R. MARKLAND

It Does Not Look Good to George

I do not think the idea of installing two 750-kw turbines would be as cheap as power is now purchased.

According to the statement, 136,000-kw-hr at $0.016 per kw-hr, including the demand charge, the cost is $2176.00 per month.

Before the war, power plants were built at a cost of $100 per kw. This would mean that $150.00 would have to be spent for the turbines. At 6 percent interest on the investment, this would amount to $9000 each year. Taxes would be increased.

I am not familiar with the water rate on non-condensing turbines, but from experience, I am of the opinion that there might be some surplus steam even in winter with the building heating load.

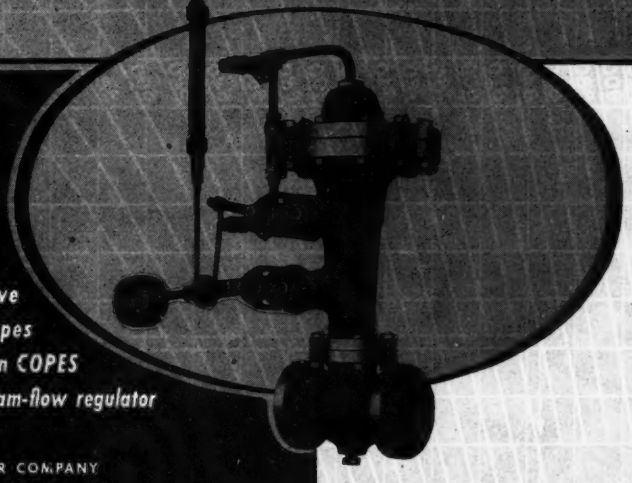
The sensible thing to do would be to have some competent engineer make a study of the load conditions. The high demand cost may be caused by some load condition that may be corrected. The equipment in motors may be old and the power factor very low. Synchronous motors may be added in place of squirrel-cage motors. Capacitors could be added to the system to boost the power factor. The contract with the local power company should be studied.

There are a lot of headaches in the local generation of power on a small scale, especially in these times of shortage of skilled labor and the high cost of supplies.

GEORGE G. AVANT

Wilmington, N. C.

PAY ONLY FOR MODERNIZATION CONVERT TO FLOWMATIC



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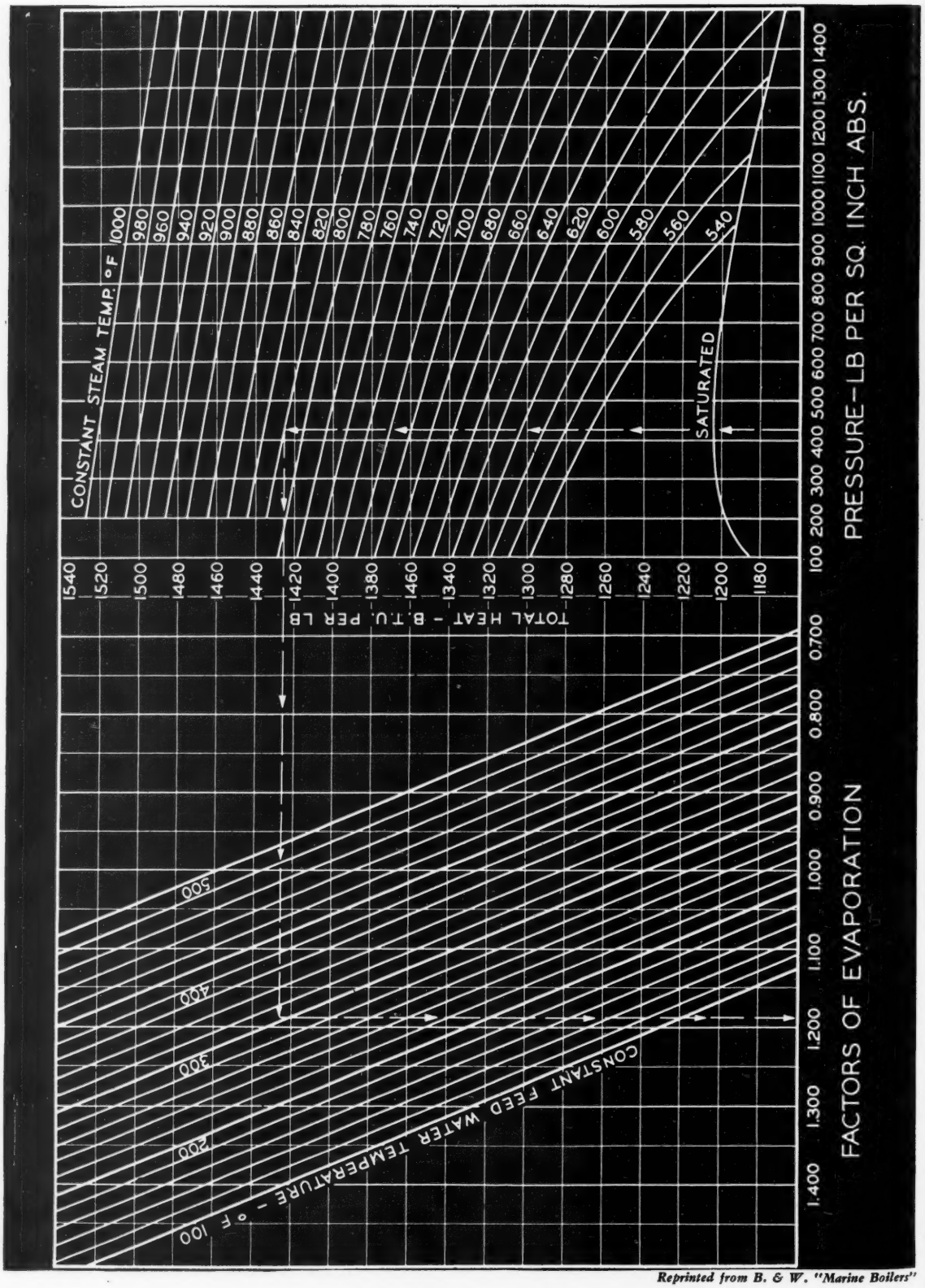

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OILS FOR AMERICAN INDUSTRY

How Business Can Regain Leadership

(Continued from page 69)

area in which private capital, management, and labor may operate, nor do they approve government regulation that stifles personal initiative and profit-or-loss adventure.

Business, Too, Must Plan

Business knows that for a long time there have been accumulated wants of our people that have not been met. Prior to the war, we had the resources with which to meet the people's needs but we failed to get together ourselves to do a practical planning job of providing the ways and means. The needs have continued to accumulate all during the war. After the war will we be ready to provide more and better housing for millions of ill-housed families—more consumer goods at lower prices—needed public works? Not unless we make plans beforehand.

We have made great progress in production—in agriculture, manufacturing, mining, and other fields. Has our increased efficiency and economy in production been reflected as far as possible in prices to consumers? Have our achievements in distribution kept pace with our productive achievements? I believe not. Surveys of the relation of production costs to ultimate market prices of many kinds of goods indicate much yet to be done toward low-cost distribution.

Agriculture is certainly not in a state of complete health. It is on sick relief. It should not require enormous government subsidies year after year, seemingly without end. Industry and trade take part in agriculture. Industry provides the machines and tools, the fertilizers, and other equipment for crop production; and most agricultural products are processed by industry, afterwards passing through trade channels on their way to the ultimate consumers. It is apparent that the organizing, engineering and marketing skill available to business can give even more help than it has given to restore agriculture to a basis of self-support.

The Start of a New Industrial Era

Our industries are spending some hundreds of millions of dollars a year on research—seeking new and improved processes and products. Government agencies and educational institutions also are pursuing many kinds of research. All this has contributed enormously to our economic progress. But we are told that we have only begun to explore the frontiers—that what we know is but a fringe of the probably knowable unknown. A surge of new things will be needed after the war to keep the wheels of industry turning at an unrelaxed tempo.

But invention alone does not put new processes and products into use, or make new things commercially valuable. Between a potentially useful invention and its actual use may intervene years of experimentation and development, careful exploration of markets, a large investment. Out of a multitude of costly failures come some successes—new industries or new enterprises by existing industries, which make for economic progress. In our provisions for regulation of enterprise, therefore, in our tax system, in our industrial operations, every practicable encouragement must be extended to economic adventure.

For some years we have been experiencing more or less turmoil in employer-employee relations. Perhaps these are the birth throes of an era of better mutual understanding. In many lines of business, satisfactory relations have been maintained for a long period of years—indeed for a generation or more. Surely the separation of labor and management into armed camps, policed by government to maintain a truce with a degree of neutrality sometimes questionable, is not a permanent substitute for relations of mutual understanding, with arrangements for internal adjustment of differences, among persons engaged in a common enterprise. The well ordered household normally needs no policing.

Wanted: the Opportunity to Earn Security

Few will now question that there must be some insurance of workers against sickness, old age, and unemployment. Society has assumed a certain measure of responsibility in this regard, and this is likely to be extended. Business, however, should have full credit for what it undertakes whereby the burden on the rest of society is lightened. And social security measures should be so adjusted and administered as not to remove or impair incentives to individual thrift and forethought—for individual opportunity to earn security is a driving force for enlargement of the common welfare.

All segments of business should recognize the wisdom of avoiding increases in prices not made necessary by rising costs. If business is serious in its desire for stability it must discourage by its own example overmortgaging the future—as in unnecessary accumulation of inventories or in unwise expansion of installment selling. Manufacturing must look to the extension of training programs, so that skills will be taught that can be applied also to future productive needs, in order to further the production and distribution of more goods and services at lower costs to a larger number of people.

There is no doubt that the improvement of industrial processes, by the introduction of new machinery, for example, and other means of increasing productive power per worker, has too often in the past caused temporary unemployment and sometimes a serious dislocation of labor. Recognizing this responsibility, manufacturers face the duty of making every possible effort to provide other employment opportunities for displaced employees, and in lieu of a job, to find ways for providing substantial dismissal benefits. The encouragement, in cooperation with educational authorities, of special vocational training for other work is an important phase of this movement.

We can all keep ourselves busy meeting our needs, producing the goods and services by exchange of which we live. There is no need of unemployment of the employable. That is if, spurred by the war, our economic groups get together, without mutual suspicion and in patriotic sincerity, to recover a common understanding that we must produce more to have more; if we expedite the flow of creative capital and creative energy into productive enterprise—then the extra effort and sacrifice that our national security now so imperatively requires will reopen for us the path of progress.

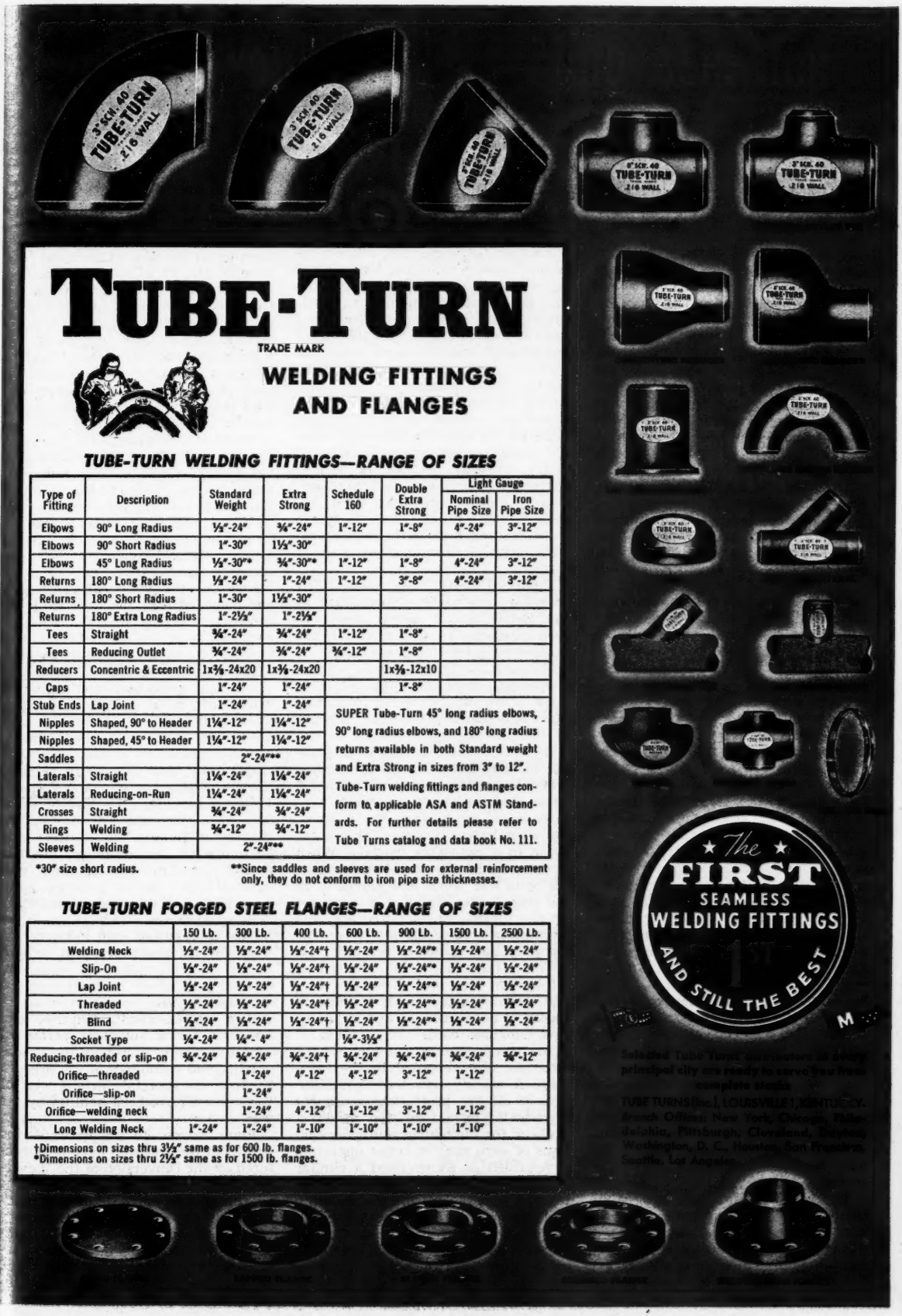
Tear Down Those "Spite Fences"!

No one economic group can solve our economic problems—much less, as an economic group, can it give direction or salvation to our society. But every economic group can cooperate with others to remove the obstacles to progress. We cannot keep business fenced off from other social institutions.

Throughout, we of business must keep our own houses in order, and justify by our use of it the freedom we defend. It has been by the effort and resourcefulness of business and industry that manufactured goods and distributing processes have been so improved year by year as to give more people more and better products at lower prices. Today enlightened managements are taking measures to cushion the effects of the temporary dislocation of employment by machinery, to keep employees informed of the conditions and policies of the enterprises in which they are engaged, and to give them a justified sense of a common interest with investors and management that all must cooperate to protect and advance.

Within industry, as a central element of our economic system, there is need of increased cooperation not only among units in the same field, through their associations, and among industrial managements generally, but also between management and labor. The intervention of government, often handicapped by political considerations, will be less frequently required, regulation by government bureaus and commissions will be administered with less confusion and arbitrariness, if industry sets its own house in order.

(Continued on page 132)



TUBE-TURN WELDING FITTINGS—RANGE OF SIZES

Type of Fitting	Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge	
						Nominal Pipe Size	Iron Pipe Size
Elbows	90° Long Radius	½"-24"	¾"-24"	1"-12"	1"-8"	4"-24"	3"-12"
Elbows	90° Short Radius	1"-30"	1½"-30"				
Elbows	45° Long Radius	½"-30"*	¾"-30"*	1"-12"	1"-8"	4"-24"	3"-12"
Returns	180° Long Radius	½"-24"	1"-24"	1"-12"	3"-8"	4"-24"	3"-12"
Returns	180° Short Radius	1"-30"	1½"-30"				
Returns	180° Extra Long Radius	1"-2½"	1"-2½"				
Tees	Straight	⅜"-24"	¾"-24"	1"-12"	1"-8"		
Tees	Reducing Outlet	¾"-24"	¾"-24"	¾"-12"	1"-8"		
Reducers	Concentric & Eccentric	1x⅜-24x20	1x⅜-24x20		1x⅜-12x10		
Caps		1"-24"	1"-24"		1"-8"		
Stub Ends	Lap Joint	1"-24"	1"-24"				
Nipples	Shaped, 90° to Header	1¼"-12"	1¼"-12"				
Nipples	Shaped, 45° to Header	1¼"-12"	1¼"-12"				
Saddles		2"-24"**					
Laterals	Straight	1¼"-24"	1¼"-24"				
Laterals	Reducing-on-Run	1¼"-24"	1¼"-24"				
Crosses	Straight	¾"-24"	¾"-24"				
Rings	Welding	¾"-12"	¾"-12"				
Sleeves	Welding	2"-24"**					

SUPER Tube-Turn 45° long radius elbows, 90° long radius elbows, and 180° long radius returns available in both Standard weight and Extra Strong in sizes from 3" to 12". Tube-Turn welding fittings and flanges conform to applicable ASA and ASTM Standards. For further details please refer to Tube Turns catalog and data book No. 111.

*30" size short radius.

**Since saddles and sleeves are used for external reinforcement only, they do not conform to iron pipe size thicknesses.

TUBE-TURN FORGED STEEL FLANGES—RANGE OF SIZES

	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
Welding Neck	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Slip-On	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Lap Joint	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Threaded	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Blind	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Socket Type	¼"-24"	¼"- 4"		¼"-3½"			
Reducing-threaded or slip-on	⅜"-24"	⅜"-24"	⅜"-24"†	⅜"-24"	⅜"-24"*	⅜"-24"	⅜"-12"
Orifice—threaded		1"-24"	4"-12"	4"-12"	3"-12"	1"-12"	
Orifice—slip-on		1"-24"					
Orifice—welding neck		1"-24"	4"-12"	1"-12"	3"-12"	1"-12"	
Long Welding Neck	1"-24"	1"-24"	1"-10"	1"-10"	1"-10"	1"-10"	

†Dimensions on sizes thru 3½" same as for 600 lb. flanges.
*Dimensions on sizes thru 2½" same as for 1500 lb. flanges.

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Operating Details at Ralston Purina

(Continued from page 76)

ter for regeneration would be available without regard to the effluent automatic valve positions.

To accomplish this, two 1-in. solenoid operated valves are installed, one on each discharge line of the H_2Z and Na_2Z softener units. Ahead of each valve is a pressure switch, connected to close both valves if the pressure in either line decreases below 10 psi. Each solenoid valve is also connected, as shown in Fig. 4, to close upon operation of a float switch on the storage tank. Power for this control system is supplied by a 2-kw house transformer.

The valve on the H_2Z effluent line had to be stainless steel to resist acidity, and one part of the pressure switch also had to be of stainless steel. The other valve on the Na_2Z effluent line is bronze. A length of rubber-lined-pipe is used between the H_2Z unit and the head box, for safety in handling the dilute H_2SO_4 in solution in the effluent.

A failure of energy, the burning out of solenoid coils, or a broken spring between coil and valve leaves the solenoid valves in an open position, so that either of the effluents can be manually controlled from hand valves on the influent to both softeners.

Each solenoid valve is equipped with an "MU" switch mechanically connected directly to the valve linkage so if a failure of the fusatron, coil or spring should occur, the signal lights would not be uniform in color, thus warning the operator of a flow stoppage in one or the other of the effluent lines.

The storage tank when full contains treated water for over two hours' operation, and since the plant has experienced very few failures of outside power, the possibility of shutdown from this cause seemed remote.

The storage tank is usually referred to as the surge tank because it performs that function with respect to the condensate pumps handling heating system and process returns, which are fed to this tank direct.

Results from Amplified Treatment System

One of the principal objects in control of the water treatment system originally was to make it as foolproof as possible. Before the war, only one man was on duty in the boiler room at night and it was desired to make the treatment system as easy for him to handle as possible. This had many advantages after the war began when manpower was scarce.

The plant is equipped with sufficient water-testing equipment to conduct all necessary raw water, treated water and boiler water tests, including the chloride test, made daily.

As a result of the operation of the new water treatment system, the boilers operate for long periods without cleaning or corrosion trouble and the piping corrosion due to CO_2 has been greatly reduced. After straight sodium zeolite treatment plus 498 ppm of sodium sulfate, CO_2 in the steam was 139 ppm. Now, after the combination Na_2Z plus H_2Z treatment plus degasification, the CO_2 in the steam is 6 ppm. Figures 5A and B show conditions maintained in January, 1941.

Good Record System Shows Performance and Costs

Another feature of this plant is its record system, unusual for a plant of its size. This system results from the fact that the plant at Battle Creek is only one of a number of the Ralston Purina Company's plants. All engineering and accounting for the various plants are supervised from central organizations at the company's headquarters in St. Louis. Hence all costs of manufacturing must be calculated accurately. Also, the central engineering department of the company requires the highest engineering standards in all its plants, hence accurate operating data are necessary to acquaint both the plant operators and the central engineering office with performance as well as costs.

Figure 6 shows a number of the important operating records kept at the Battle Creek power plant. In such a process plant, lubrication, for example, requires constant study. A lubrication system has been worked out based on weekly operation, a week in this industry being figured by a predetermined number of "dumps" of the process equipment.

A sheet is made out for each process machine showing its lubrication schedule and frequency of servicing. From that a maintenance man's card is made out as shown in Fig. 6, showing what has to be done. That sheet is put in a tickler file by date. When it comes out, the maintenance man performs the work and enters it on the sheet, after which it is recorded in the office. The electricians and maintenance men fill out a similar form for each motor or machine.

This information is all entered on a 5-by-8-in. key card. Thus the complete maintenance and lubrication record of each machine and its motor gets onto one card.

Air compressor and motor wiring data are also recorded in the same way. A weekly report of the condition of all fire protection equipment is recorded on a form for checking. A check for the hourly routine operations of each shift of boiler operators is provided as shown, and a similar check sheet reminds the operators what to look for in the monthly boiler overhaul and inspection and in power house maintenance. Careful records of the water tests, readings of the flow from the water softeners and the like are kept on a softener log sheet.

Byproduct Fuel from New Paper Process

AMERICAN PAPER mills, using the sulphite pulping process to manufacture paper pulp, lose 10,000 tons per day of recoverable lignins, carbohydrates and the chemicals employed in the extraction or cooking operation, L. S. Wilcoxson, Executive Assistant, The Babcock and Wilcox Co., told the Maine-New Hampshire Group of the Technical Association of the Pulp and Paper Industry in a meeting at the Hotel Elmwood, Waterville, Me., on May 11. In addition, this "waste," which is pumped out from the paper mills in liquid form to adjoining streams, pollutes the waters, killing off fish and plant life.

An answer to the problem may be found in a change in the chemical used in the acid process from a calcium base to a magnesium base, a process developed jointly by The Howard Smith Paper Mills, Montreal, Canada, and The Babcock and Wilcox Co., New York; and independently by the Weyerhaeuser Timber Co., Longview, Washington.

"When magnesium bisulphite is employed as the cooking liquor, the no longer "waste" liquor can be satisfactorily evaporated without scale formation, the chemicals recovered and recycled, and the heat from the combustion of the lignins and carbohydrates used for the efficient generation of steam," the speaker said.

Explaining that only a limited or small percentage of material now wasted can be used for commercially saleable items such as vanillin, alcohol, yeast, oxalic acid, road binders, cements and lignin plastics, Mr. Wilcoxson said that there still remains the problem of the economic disposal of the remainder. The waste products might be rendered non-toxic so that fish and marine vegetation would be uninjured, he continued, but this would constitute an additional cost against every ton of pulp produced by a mill, and therefore would be a definite economic disadvantage in the highly competitive pulp industry.

Following laboratory and experimental investigations, a semi-commercial pilot plant incorporating the magnesium base operation, was installed at Cornwall, Ontario, and operated for a sufficient period of time to prove conclusively the practicability and economics of the process. Further commercial installations of the process have been held up by the war.

Plans made to incorporate the results of the research have been centered on the conversion of the Weyerhaeuser Sulphite Mill at Longview, Washington to magnesium base operation, but the entrance of this country into the war in December, 1941, prevented this program from being carried out. The plant will be constructed as soon as necessary critical materials are available.

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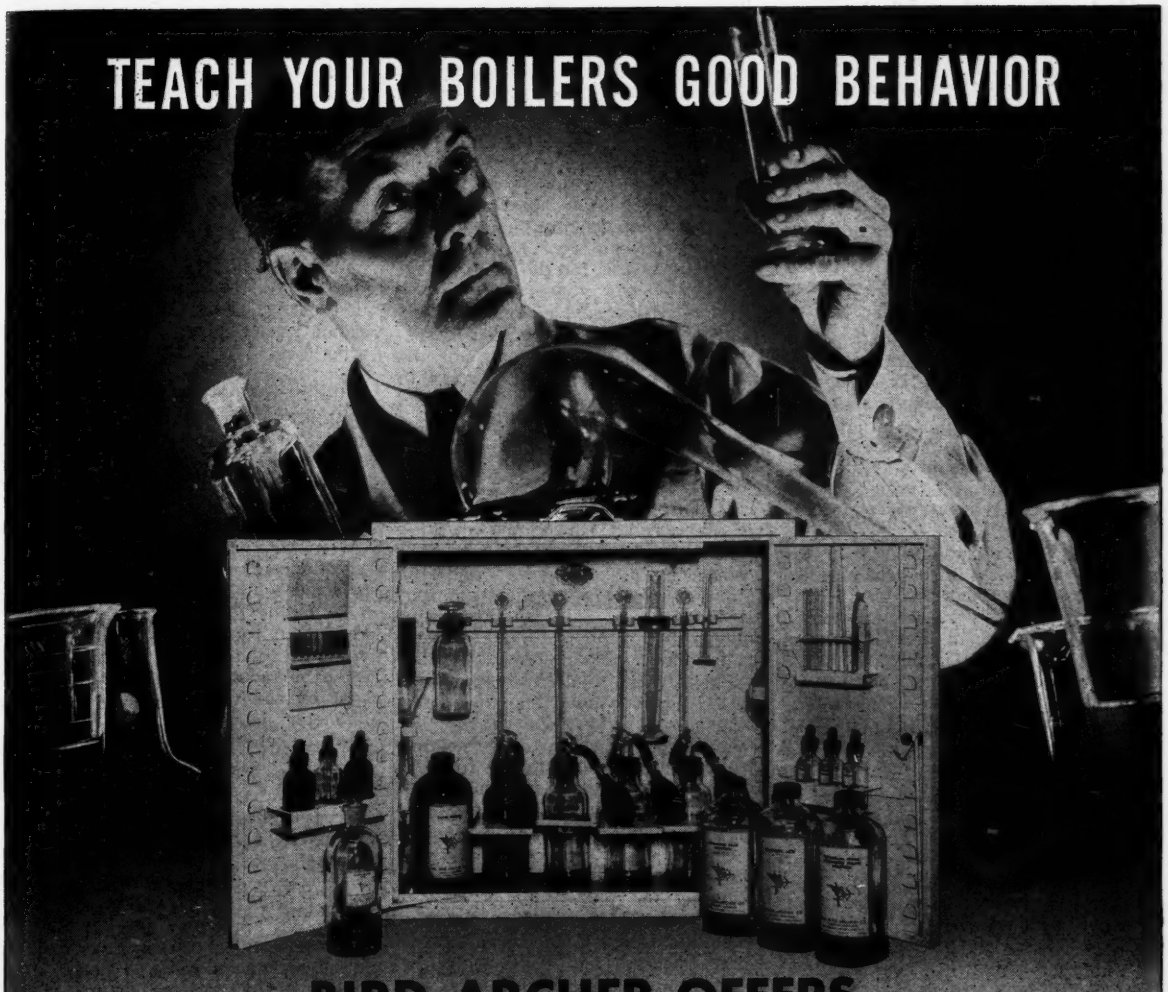

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Selecting the Motor for the Application

(Continued from page 86)

tremely high values of WR^2, and motors with normal starting torque characteristics may require from 30 seconds to 1 minute to accelerate. With starting current flowing in both the rotor and stator for this long period of time it may generate sufficient heat to damage the winding either in the form of a charred insulation on the primaries. What is more probable, the rotor winding will get so hot that the bars and rings will warp and bend and eventually crack and break. To meet this application with a squirrel cage motor a special Class 1 motor is used to reduce the starting current to a minimum and then the rotor of the motor is designed with a large mass of material especially in the end rings so that it is possible for the motor rotor to absorb the tremendous losses during the accelerating period without reaching excessive temperatures. Once the motor reaches its full load speed the losses return to normal and the rotor rapidly cools down to its normal operating temperature.

Another continuous running motor application which requires special consideration is on drives where there is high external inertia quite often in the form of a flywheel and where the load instead of being of a continuous full load torque is pulsating in nature. Typical examples of this type of application are presses and bolt headers. In this type of application no work is being done for the majority of time and then a peak load occurs which may require torques many times the full load torque of the motor. Under these conditions the running efficiency of the motor at full load is not important because it never operates at that point, and therefore the motor is deliberately designed with more than normal secondary resistance so that it has a tendency to slow down as the load comes on the drive. This tendency for the motor to slow down permits the flywheel to give up energy to absorb the peak load with the motor exerting no more than full load torque. However, the energy that is taken out of the flywheel during the work stroke must be returned to it by the motor, and therefore the motor must have sufficient torque to accelerate the flywheel before the next work stroke is made. Since presses work at widely varying rates, say from 2 or 3 work strokes per minute to as high as 100 to 150 work strokes per minute, the correct amount of rotor resistance will vary depending upon the number of strokes per minute made. On the extremely large presses making only a few strokes per minute there is ample time for the flywheel to slow down 10 to 15 per cent during the work stroke and give up a considerable part of its kinetic energy. Therefore, motors used on this type of press should have high slip, and one of the standard ratings listed by the motor manufacturers is a motor having 8 to 13 per cent slip, and is the correct motor to use.

As the number of strokes per minute increases, the length of time of the working stroke decreases, and there is not much time available for the flywheel to slow down, nor is there much time for the motor to reaccelerate the flywheel between strokes, so that the amount of slowdown of the flywheel is usually between 5 and 10 per cent and the standard line of press motors with 5 to 8 per cent slip press has been designed for this application. These presses usually make in the neighborhood of 10 to 40 strokes per minute.

On the smaller presses making 100 to 150 strokes per minute there is very little time for the flywheel to accelerate or decelerate, and the standard motor which has approximately 3 per cent slip is entirely adequate for the application and there is no object in supplying the high slip motor. Quite often someone tries to use Class 2 motors on these high torque applications, and if they do not have trouble due to overheating trouble may develop in the form of mechanical failure of the rotor due to the unequal heating in the double deck winding as previously explained.

These special applications just described are fairly simple so far as applying the proper motor is concerned, and rather accurate calculations can be made to determine the motor heating and thus apply the proper motor. However, there is another group of applications which involves frequent starting and stopping or reversing which may or may not involve variable running loads and even periods when the motor is at rest. These applications are much more difficult to calculate and also it is usually hard to get a set of fixed operating conditions. Typical applications of this type include small hoists, skip hoists, reversing turret lathes, drilling and tapping machines, and centrifugals of various kinds. Usually applications of this type have external WR^2's that are roughly comparable to the WR^2 of the motor rotor itself, and in fact in most cases every attempt is made by the machinery builder to reduce the inertia of the revolving parts, since it is obvious that the heating of the motor is directly proportional to the inertia of the drive. Some applications require 40 to 50 reversals per minute and 15 to 10 reversals per minute are common.

No attempt will be made here to set up methods for calculating the losses on a given duty cycle but merely to point out some of the factors that determine the design of the proper motor for the application. In the first place the losses in the motor for a drive of this type can be divided into two parts—the losses during changes in speed and the running losses. Unfortunately, an increase in rotor resistance which tends to reduce the motor losses for changes in speed, tends to increase the losses while running at constant speed. If the size of the motor has been determined by the torque required to give rapid acceleration and deceleration and has a very light running load, then the running losses can be largely ignored. If on the other hand the motor must carry full load torque after it has accelerated to full speed, then it is important to keep the slip to a minimum amount.

As previously mentioned, it is also important to keep both the WR^2 of the motor and the load to a minimum. After the machinery builder has designed his machine to reduce this value to a minimum, then it is up to the motor manufacturer to proportion the rotor to keep the motor WR^2 to a minimum. Even though squirrel cage motors are compact in design and small for the HP rating delivered, the inertia of the rotor can often be reduced as much as 50 per cent by changing the ratio of rotor diameter and length from what is used on general purpose motors.

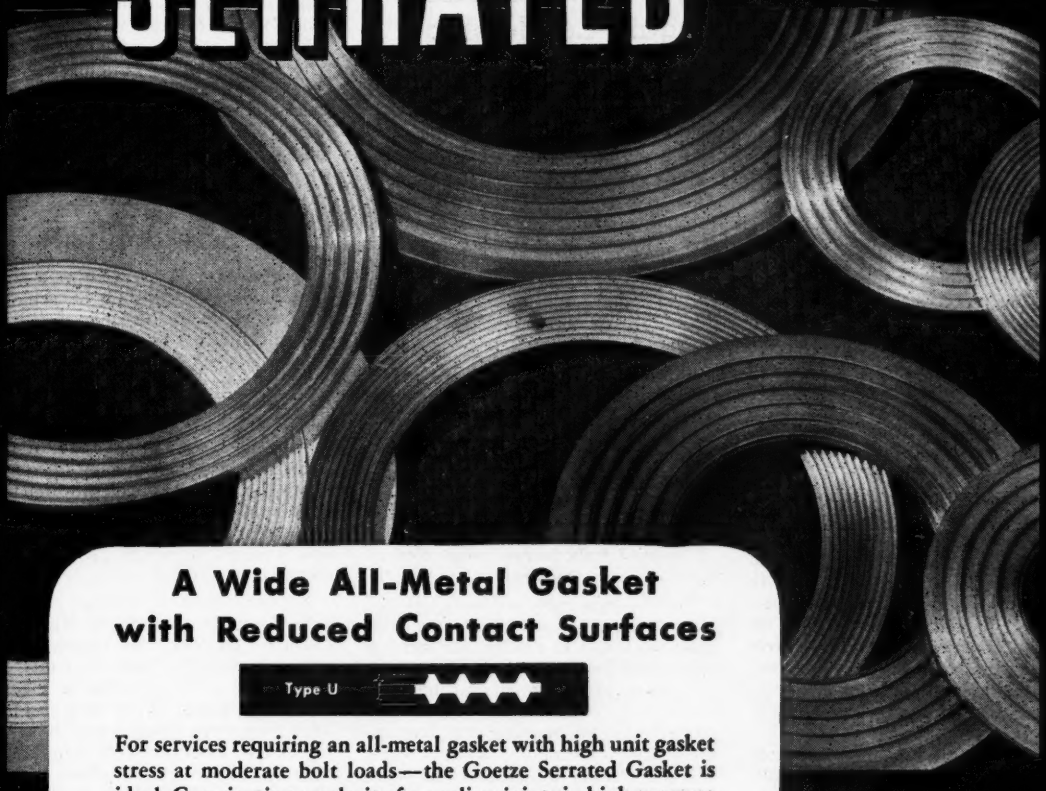
Ventilation

Athough we have definitely avoided discussing various mechanical modifications that are often required on squirrel cage motors, it is desirable to consider the ventilation of the motors and the type of insulation used. We all know that it is quite often desirable to build the motor into the machine or to make the motor totally enclosed to protect it from cast-iron dust, oil fumes or other dirt in the atmosphere surrounding the motor. These enclosures restrict the ventilation of the motor and reduce the amount of heat that can be dissipated by the motor. Even with the motor ideally designed for the application, the losses on duty cycle operation are usually higher than for a motor operating continuously at a constant load. The amount of losses that can be dissipated by a motor with a given temperature rise is usually roughly proportional to the radiating surface of the motor when it is totally enclosed or in proportion to the amount of air circulated through it when of the open type.

When it is satisfactory to supply an open motor the temperature rise of the motor can be kept down by supplying a more elaborate blower mechanism on the rotor than normally supplied which tends to circulate a much larger volume of air and thus keep down the temperature. However, care must be exercised that this additional rotor does not materially increase the WR^2 of the unit. Of course, you can always increase the size of the motor and therefore dissipate more losses, but this is unde-

MODERN DEVELOPMENTS OF GASKET RESEARCH

SERRATED . . .



A Wide All-Metal Gasket with Reduced Contact Surfaces

For services requiring an all-metal gasket with high unit gasket stress at moderate bolt loads—the Goetze Serrated Gasket is ideal. Growing in popularity for sealing joints in high pressure steam, process equipment and piping, this gasket is supplied in a wide range of materials and with serrations of a pitch designed to meet individual requirements of specific operating conditions.

An excellent example of advanced Gasket Engineering, this type is literally custom-built to meet the specifications of each use. The Serrated Gasket is another illustration of Goetze mechanical and metallurgical research that is producing the many modern developments in Gasket Engineering about which you will want to know.

Ask to have your name added to the list of engineers receiving "The Gasket"—a series of technical bulletins containing original gasket data emanating from the Goetze Research Laboratory. Write on your company letterhead giving your position.

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LOWELL THOMAS Speaks on New Gasket Film

Now available to employee groups, technical societies, engineering schools and other organizations throughout the country, this new 35-minute Kodachrome film, "Only a Gasket," tells why these are the "Biggest little things" in modern Industry. Write for full information.

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"America's Oldest and Largest Industrial Gasket Manufacturer"

sirable from a space standpoint and also the size must be increased in such a manner that the rotor WR^2 is not increased to gain much advantage. On many severe duty cycle jobs we find that even with the best possible electrical design the losses are sufficient to cause temperature rises in the motor higher than can be withstood by normal Class A insulation, and in these cases the answer is high temperature insulation. For many years Class B insulation has been recognized as a standard type of insulation for motors, and it permits the motor to operate at a 75° rise instead of a 40 to 55° rise. Class B insulation makes use of the best insulating materials that are available, such as asbestos, mica, and glass. However, it is used only where necessary due to a considerable increase in cost of the motor so equipped.

A new type of insulating material has been recently developed in the form of silicon resins, and when these materials are used to impregnate motors insulated with glass and mica materials, temperature rises of as much as 150° C. or even higher can be tolerated without damage to the motor winding. While it can be said that the use of this type of material is still in an experimental stage, a great deal of work has been done and we have installed several motors with this type of insulation. We have deliberately picked spots where we could replace a motor that was frequently burning out either due to excessive loads, high ambient temperatures, or mounted in a place where no ventilation is obtained.

High temperature insulation promises to be the solution of many applications, but we must be careful to remember that high temperature insulation is the solution to the problem only when heating is the limitation of the machine design. On standard open motors running under normal operating conditions some other factor is quite often the limitation. For instance, motors must be designed to have certain torques, both starting and pull-out, power factor, and efficiency. We know that our standard open motors meet these requirements, and the temperature rise is often less than 40°. It is true that it is possible to redesign the motors and obtain the HP rating on a smaller frame size and still get good values on efficiency, but quite often the starting and pull-out torque is reduced or else the power factor is reduced. However, on the special applications mentioned above where we can obtain the necessary electrical characteristics as far as torque and efficiency are concerned in a given frame size, but our motor will overheat due to the duty cycle, then the high temperature insulation has a definite place in the picture.

A disadvantage of the high temperature insulation besides its greater cost is that the high temperature of the motor itself transmits heat to other parts of the machine and may cause distortion and inaccuracy in the work being done. This is especially true on machine tools doing precision work.

How Business Can Regain Leadership

(Continued from page 126)

And we must not assume that people will long endure the prevalence of poverty in the midst of plenty, inability to distribute widely the amazing achievements of the Machine Age, extensive denial of opportunity through conditions of human creation, and a degree of insecurity for large groups of our people that is surely unnecessary in this modern world. In such circumstances masses of men may be easily led into sacrificing a freedom which they find faltering for a promised security which is dangled before their troubled eyes. Political patterns which promise social order and social certainty under arbitrary rule arise not only where democracy has never been tried but also where it has been found temporarily inadequate to satisfy human aspirations.

"Rugged Individualists" Must Work Together

For too long have we been diverted by our separate interests; too long have we failed to realize our increasing interdependence; too little have we taken advantage of our habit of association to develop a common responsibility for making our increasingly complex economic system work. We can readily agree that our economic and social problems will be solved better by free men cooperating with enlightened self-interest than by the arbitrary rulers of any totalitarian state. But we must have the will, a patient but persistent determination, to solve them rapidly and progressively, if we are to prove the superiority of our free way of life.

Our emotions have been stirred, too slowly perhaps, but now deeply, by a threat of encirclement by hostile force. We are working together with might and main to destroy that threat. The energy and resourcefulness of a free people are being demonstrated by miracles of production, produced not under coercion but in voluntary patriotic effort.

Who has a greater interest than business men in the resumption of our progress toward a higher level of economic welfare for all our people? The 130 million people of the United States are our customers. We are all in a sense one another's customers for the goods and services we can furnish. In the long run none of the occupational groups in which the census classifies us can prosper except with the prosperity of all. Not only for the reasons that prompt us as good citizens and civilized persons, but also for reasons of self-interest as business men, we want relief of unemployment, poverty, and distress among our pepole, and removal as far as possible of the conditions that cause them.

Business, keeping its freedom and using it with constructive effort and social vision, can make America more than ever a land of opportunity—where all people, pursuing occupations of their own free choice, respecting one another's liberties, recognizing their social responsibilities, may exercise their basic right to be what they have it in them to be.

More Schadenlust

IN THE MAY ISSUE we ran a short piece under the heading of Schadenlust, which is the German word expressing the lust to destroy or to create damage. As time goes on and as more information comes in from Europe we hope to be able to publish more details regarding the restoration of power service in the war-torn areas as the allied armies moved in. From the scattered accounts reaching us, few of us over here have any conception of the indescribable destruction wrought by wholesale and methodical demolition.

Naples offers a typical example. When the Allies entered Naples on October 1, 1943, the nonresidential parts of the city were in ruins, the entire city without lights or electric power, telephone or air raid systems; its sewers were clogged and overflowing in the streets, and its people were suffering from thirst after the destruction of the water supply, and famished because all the food supplies had been stolen or exhausted. The Germans had a corps of 4000 demolition experts on Naples for a full month. They did a thorough job. Naples had a completely automatic dial telephone service. The Germans blew up the main exchange in such a way that the walls and the roof fell in. The equipment was smashed and the thousands of cables and wires left in a hopeless mass.

It was a difficult job but our engineers pitched in. Engineers set to work rebuilding the pumps. The Navy supplied three small submarines which supplied limited electric service to get the pumps in operation. It was a month before it was possible to have electric power in any quantity and six months before there was enough for all needs. After the emergency use of the submarines, the engineers succeeded in repairing a Diesel power plant, then a steam plant.

The Signal Corps did a difficult job of tracing out the tangled skeins of telephone and cables and, using a suburban exchange provided the military with 2000 automatic phones in ten days.

"Tomorrow is *another* day"

Because, for almost a century, Powell Engineering has been anticipating the flow control requirements of products and processes still in the laboratory stage, Powell was ready to meet—and has met—every new demand imposed by war. Today we can justifiably say "there's a Powell Valve for every *known* requirement of industry."

But "tomorrow is another day" and it will bring new problems in flow control. Powell, as always, will be ready to solve them.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

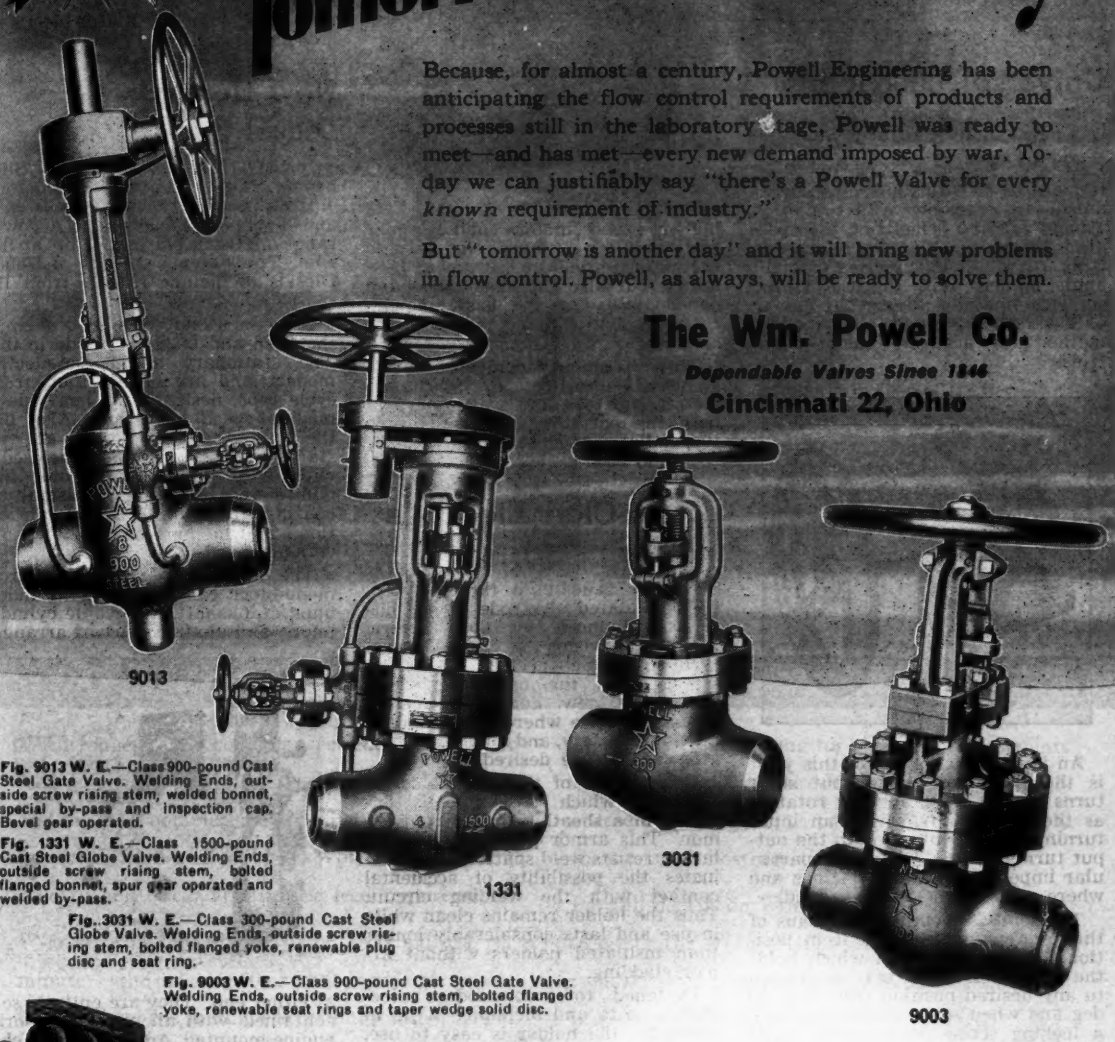
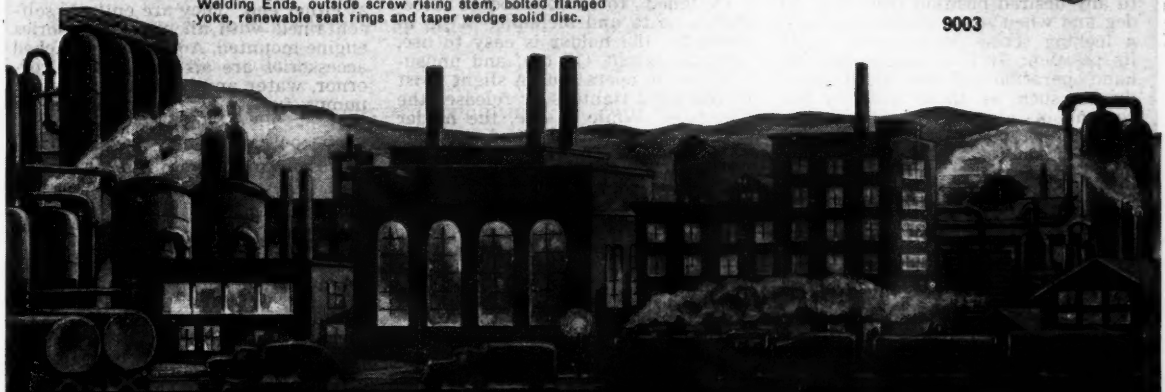


Fig. 9013 W. E.—Class 900-pound Cast Steel Gate Valve. Welding Ends, outside screw rising stem, welded bonnet, special by-pass and inspection cap. Bevel gear operated.

Fig. 1331 W. E.—Class 1500-pound Cast Steel Globe Valve. Welding Ends, outside screw rising stem, bolted flanged bonnet, spur gear operated and welded by-pass.

Fig. 3031 W. E.—Class 300-pound Cast Steel Globe Valve. Welding Ends, outside screw rising stem, bolted flanged yoke, renewable plug disc and seat ring.

Fig. 9003 W. E.—Class 900-pound Cast Steel Gate Valve. Welding Ends, outside screw rising stem, bolted flanged yoke, renewable seat rings and taper wedge solid disc.



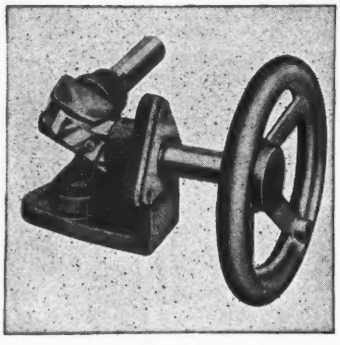
POWELL VALVES

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. Write to POWER PLANT ENGINEERING 53 W. Jackson Blvd., Chicago 4, Ill.

Universal Link Joint

THE PIEZO UNIVERSAL LINK JOINT, is a new remote control product developed by Piezoelectric Corp., 110 East 42nd St., New York 18, N. Y. It features an adjustable link mechanism to transmit rotary motion around corners, permitting the operation of shafts at angles adjustable from a straight line, 0 deg to a right angle, 90 deg. With the use of solid shafting and the absence of flexing or backlash this makes an excellent method for accurate remote controls.



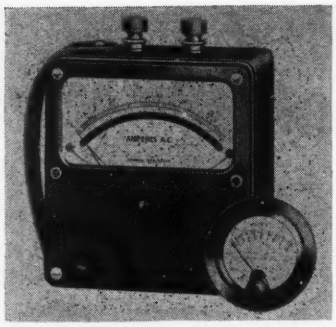
An important feature of this joint is the fact that the output shaft turns in the exact angular rotation as the input shaft, giving an input turning angle equivalent to the output turning angle. This is of particular importance in dial settings and where uniform motion is desired.

The joint is mounted by means of three screws which hold it in position. The bearing arm which holds the adjustable shaft may be hinged to any desired position from 0 to 90 deg and when in its proper location, a locking screw permanently holds its position. It is recommended for hand operation and slow speed power drives, such as those used in the control of electrical switchboards, radios, automatic machinery, valve operation and many other mechanical devices.

Frequency Compensated Instruments

WESTON a.c. electrical measuring instruments can now be furnished with special forms of compensation to maintain their accuracy over the broad frequency range of from 25 to 3000 cycles, according to an announcement from Weston Electrical Instrument Corp., 617 Frelinghuysen Ave., Newark 5, N. J.

These instruments will prove highly advantageous to industry in those applications using power frequencies above 60 cycles, with the smaller associated transformers,



higher speed motors and simpler rectifier filter systems. Not only do they afford broad measurement flexibility, but also the ruggedness and dependability of the basic moving iron vane and dynamometer type instruments.

These frequency compensated instruments are furnished as ammeters, voltmeters and wattmeters in both the portable and switchboard types; flat compensated up to 1000, 2000 and 3000 cycles.

Armor-Clad Electrode Holder

A NEW ARMOR-CLAD (screw type), fully insulated electrode holder has been announced by the Electric Welding Division of the General Electric Co., Schenectady, N. Y. Designed from the operator's viewpoint, the new holder is recommended for use wherever durability, maximum safety, and minimum operator fatigue are desired.

One feature of the new holder is its head, which is completely enclosed in a sheath of aluminum armor. This armor protects the insulation, resists weld spatter, and eliminates the possibility of accidental contact with the welding circuit. Thus the holder remains clean while in use and lasts considerably longer than insulated holders without armor cladding.

Designed to accommodate electrodes up to and including ¼ in. in diameter, the holder is easy to use, light in weight (15 oz), and unusually cool in operation. A slight twist of the hand tightens or releases the electrode. While in use, the holder firmly grips the electrode at the proper angle and good current contact is maintained. This keeps the holder cool, tends to prevent overheating of the electrode, and maintains a uniform melting rate clear down to a stub end. The threads of

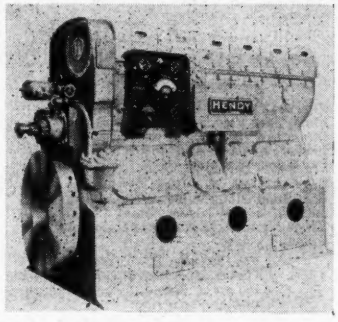
the push-up rod do not carry current. A soldered cable connection also helps the holder to remain cool. The width of the electrode slot limits the size of the electrode which can be inserted, thus preventing overloading, one of the evils which materially shorten the life of electrode holders.

New Hendy Diesel Series

JOSHUA HENDY IRON WORKS, Sunnyvale, Calif., is now producing its entirely new Series 20 Diesels in 6 and 8-cylinder models with a power range of from 190 to 250 hp at 900 rpm. This extends the line of Hendy Diesels to include ratings from 190 to 780 hp.

Like the Hendy Series 50 engines, the D-26 and D-28 are made in marine, stationary, and Diesel-electric models, and are of the four-stroke cycle type, designed for heavy-duty, medium-speed operation. Also like the larger engines, they are air starting and completely enclosed—with overhead camshaft, unit fuel pumps and injectors, precision-type bearings, and full pressure lubrication. Marine models are direct reversing.

The new engines have cast-iron, mono-block construction with underhung crankshaft, removable cylinder liners, and auxiliary drives arranged



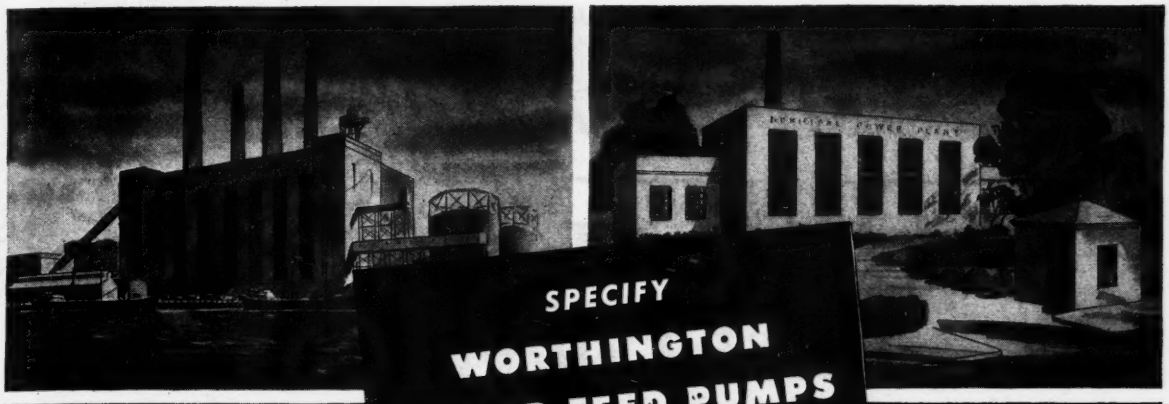
at either end. They are entirely self-contained, with all main accessories engine mounted. Among the attached accessories are air compressor, governor, water and lube-oil circulating pumps, fuel-transfer pump, lube and fuel-oil filters, lube-oil cooler, and gage board.

Series 20 engines are single acting, with 7¼-in. bore and 8½-in. stroke. The cast-iron pistons are of simple design with four compression and two oil-control rings.

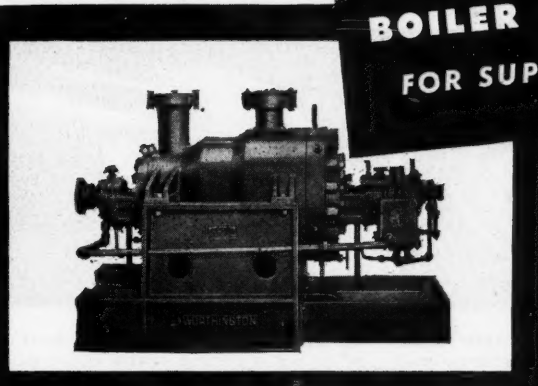
The crankshaft is cast iron, with hollow crank pins and main journals. It is dynamically balanced, with all bearing surfaces accurately ground and polished. Lubrication is carried from the main journals to the crank pins through inserted steel tubes.

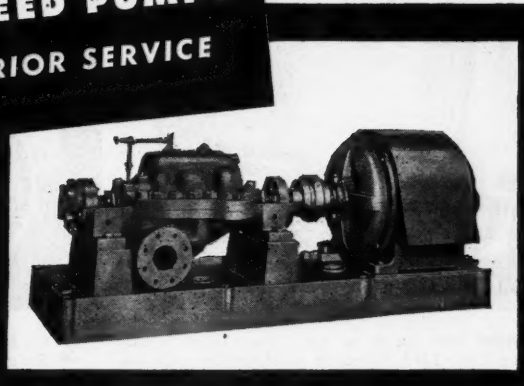
Fresh-water cooling is a design feature of the Series 20. This assures freedom from rust, scale, or chemical deposits in water jackets and materially reduces maintenance costs. The raw water enters the raw-water pump, passes through a

(Continued on page 140)



SPECIFY WORTHINGTON BOILER FEED PUMPS FOR SUPERIOR SERVICE





With longest and broadest experience with boiler feed pumps for power plants, large and small . . . and the most complete line of boiler feed pumps for pressures, high and low . . . Worthington is best able to help meet your boiler feed requirements.

Whether the capacity is 50 or 3500 gallons per minute — the pressure 50 or 2500 pounds per square inch — there is a standard Worthington centrifugal boiler feed pump available.

Familiar with every type of boiler feed application, Worthington engineers are trained to select the economical, reliable arrangement . . . fitting feed pump to feed cycle.

Out of 100 years' experience . . . pioneering . . . inventing, came Worthington improvements such as the Elastic Seal Ring for tight interstage joints . . . the Multiple Pressure-Reducing Orifice for boiler feed by-pass service . . . and the Mix-Temp Cycle for interstage heating.

For full details on Worthington boiler feed pumps of which the WC and UQ Models shown above are typical, write us or phone our nearest district office.

Worthington Pump and Machinery Corporation, Centrifugal Pump Div., Harrison, N. J.

WORTHINGTON

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THE WORLD'S LARGEST MANUFACTURER OF PUMPS

For Boiler Feed Service
Capacities from 30 to 1500 g. p. m. Heads from 180 to 1000 feet.

For Hotwell, Condensate, Chilled Water, General Service
Capacities from 150 to 1300 g. p. m. Heads from 110 to 500 feet.

For Boiler Feed Service
Capacities from 25 to 1450 g. p. m. Heads from 220 to 1600 feet.

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Capacities from 500 to 1600 g. p. m. Heads 900 to 3200 feet.

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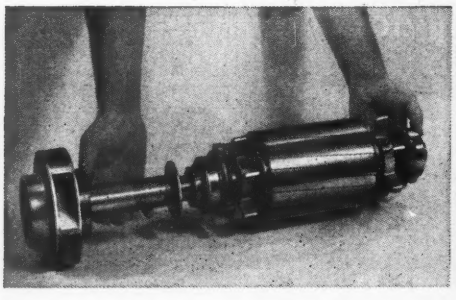
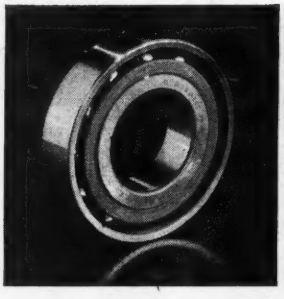
[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make CENTRIFUGAL PUMPS *Last Longer...*

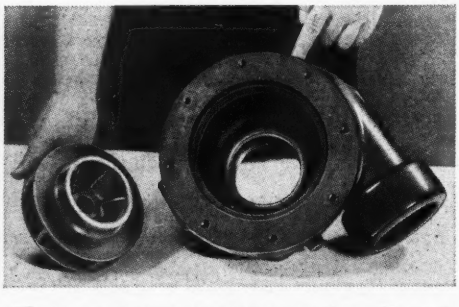




1 WHEN YOU HAVE an A-C "Electrifugal" pump you don't have alignment problems, for *both* impeller and rotor are mounted on *one* shaft. However, most pumps are coupled to separate motors... and how well the two are kept in alignment has a lot to do with how long they last. For timely help, get your *free* copy of Allis-Chalmers' "Handbook for Wartime Care of Centrifugal Pumps".

2 ALL BEARINGS AREN'T ALIKE. For example, while too much lubricant won't harm sleeve bearings, in anti-friction bearings it *promotes* friction. So play safe . use only the *right* amount of the *right* lubricant — as recommended by your manufacturer.

3 SLEEVES WEAR UNDULY when water seal piping is plugged, lantern ring displaced, water is dirty or stuffing box gland is drawn too tightly. By keeping a constant check on such sources of wear, sleeve life can be materially lengthened. For valuable tips on how to locate, how to remedy these and other pump troubles, consult the "Handbook".



4 THE KIND OF PACKING, and *how* you use it have a lot to do with how long your pumps last. Commonest cause of trouble traces back to lack of "know-how" in caring for stuffing boxes. A quick picture of the *how* and *why* of efficient packing can be found in the "Handbook".

5 AN OFTEN OVERLOOKED CAUSE of impeller and casing wear is cavitation. For if a pump's capacity, head and particularly, suction lift aren't figured properly, this enemy can eat vital parts away fast. Allis-Chalmers' "Handbook for Wartime Care of Centrifugal Pumps" contains a step-by-step method for figuring head, plus tables of losses to help you apply your pumps correctly.

TODAY, with pumps working harder than ever and replacements difficult to obtain, you can't afford to take chances on maintenance. That's why Allis-Chalmers has published its "Handbook for Wartime Care of Centrifugal Pumps".

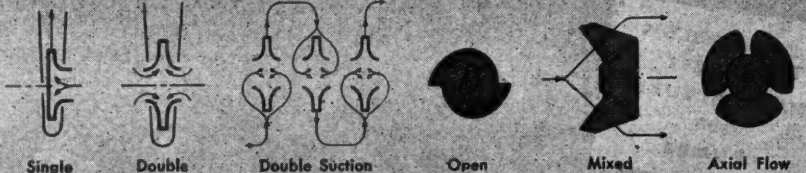
Write for your *free* copy of this valuable book today! It applies to *all* makes of pumps; contains *no* advertising.

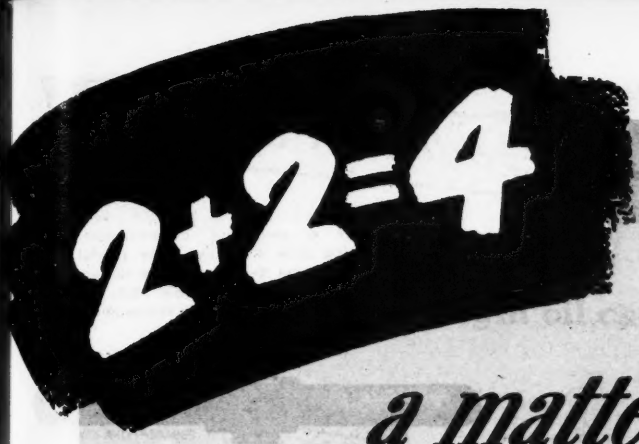
And when you *do* need new pumps, look into the extra efficiency of A-C centrifugal pumps ... the "Electrifugal", and all types for every purpose. ALLIS-CHALMERS, MILWAUKEE.

A 1776

ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.





a matter of fact...

IT'S A FACT that, in 1938, Shell Scientists and Engineers gave to the world the first turbine oil that would prevent rust in steam turbines . . . Shell Turbo Oil.

•

IT'S A FACT that a turbine oil must both prevent rust and have superior oxidation stability in order to qualify as a lubricant worthy of being entrusted to the lubrication of such a costly machine as a steam turbine.

•

IT'S A FACT that Shell Turbo Oil was the first turbine oil to combine rust-preventive qualities with superior oxidation stability.

•

IT'S A FACT that Shell Turbo Oil was the result of exhaustive research, testing and experimental work done in conjunction with the country's leading steam turbine engineers.

•

IT'S A FACT that all the laboratory tests ever made do not, in themselves, prove the worth of a lubricant in actual operation . . . that samples of Shell Turbo Oil, after 40,000 hours' operation in the turbo blower of a steel mill, where other oils lasted only 5000 hours, showed not a single sign of structural breakdown. (Shell Turbo Oil has shown this same superiority under numerous equally adverse operating conditions.)

•

IT'S A FACT that Shell Turbo Oil was the first of its type to be approved as meeting stringent U.S. Navy specifications 14-0-15 (INT) . . . that millions of gallons are being used yearly by the Navy in turbine service far more rugged than the operating conditions to be found on land.

•

IT'S A FACT that, although the Rust Test for turbine oils, sponsored by Shell, has been tentatively accepted as a standard by the A.S.T.M., there is no standard test for determining the performance characteristics of a turbine oil in service.

•

IT'S A FACT that Shell is the first and only oil company to design a procedure as well as an oil especially for the cleaning of turbine oil circulating systems, a phase of turbine operation that is being recognized by turbine operators as a necessity to efficient, modern turbine maintenance.

•

IT'S A FACT that, in the ceaseless search to obtain as perfect a turbine oil as possible, Shell developed the "Film Tenacity" test which shows Shell Turbo Oil outstanding in resisting the constant washing effects of water.

* * *

Those are the facts about steam turbine oils in general . . . Shell Turbo Oil in particular. Facts we thought every turbine owner, engineer and operator would like to know.

SHELL

SHELL TURBO OIL

"Trifles make perfection but perfection is no trifle"

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

KENNEDY METAL IS STRONG

because these fibres

The fibres you see in the small circular reproduction of a microphotograph (enlarged 100 times) of Kennedy iron body valve metal section are graphite.

When these fibres are long, wide and connected with each other, as in many examples of ordinary cast iron, the metal structure is coarse, irregular, weak and brittle. However, the short, thin, separated graphite fibres of the special metal used for all Kennedy iron body valves, permits a dense, uniform tough structure which is far stronger than ordinary cast iron.

This is why Kennedy valves excel in strength, as they also excel in features that provide greater efficiency and convenience of operation. Learn ALL the Kennedy iron body and bronze valve details and you will quickly see the advantages of standardizing on these valves for all standard services.

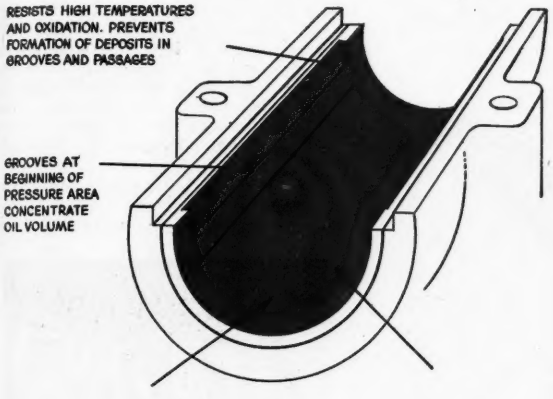
THE KENNEDY VALVE MFG. CO.

ELMIRA • NEW YORK

KENNEDY *valves... pipe fittings... fire hydrants*

STANDARD ENGINEERS NOTEBOOK

High-film-strength oil carries heavy-duty loads


RESISTS HIGH TEMPERATURES AND OXIDATION. PREVENTS FORMATION OF DEPOSITS IN GROOVES AND PASSAGES
GROOVES AT BEGINNING OF PRESSURE AREA CONCENTRATE OIL VOLUME
SPREADS RAPIDLY. COVERS BEARING SURFACE WITH UNIFORM FILM
WITHSTANDS HIGH RUBBING PRESSURES OF HEAVILY-LOADED, LOW-PRESSURE BEARINGS

Because Calol Multi-Service Oil spreads rapidly over bearing surfaces, adheres to metal and withstands high temperatures and pressures, it is used by many operators on heavy-duty bearings where maximum loads produce high rubbing action.

Calol Multi-Service Oil is made from stable base oil. Compounding gives it detergent and oxidation inhibiting characteristics. As its name implies, Calol Multi-Service Oil has many uses in industry. It is highly effective for the lubrication of natural gas engines, industrial Diesel engines, air compressor cylinders and bearings and enclosed reduction gears and their integral parts.

Calol Multi-Service Oil may be used in oil circulation systems where rapid separation from water is not required, in ring-, drop-, and bottle-oilers and for free oiling.

Available in four viscosity grades: 55X (SAE 20), 65X (SAE 30), 75X (SAE 40) and 85X (SAE 50).

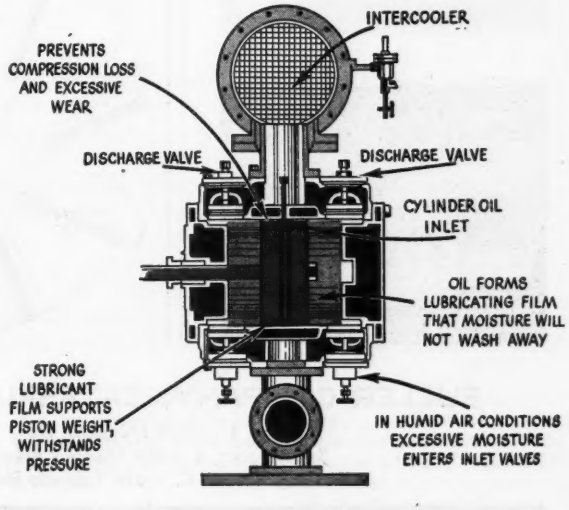
Compounded compressor oil protects against moisture

Many operators have reduced loss of compression and excessive wear on high-pressure cylinder walls of multi-stage air compressors, operating in humid air, by using Calol Compressor Oil-19X.

The extra adhesiveness of Calol Compressor Oil-19X resists the washing action on lubricant film of water from intercoolers entering with air at high velocity. Special compounds cause it to form a slight emulsion with water and stick tight to all metal surfaces protecting cylinder walls against rusting and pitting when compressor is idle.

Calol Compressor Oil-19X provides an extremely tough lubricant film. It is particularly adaptable to large horizontal compressor cylinders where piston weight is a factor.

Calol Compressor Oil-19X is also recommended for the lubrication of compressors on air-injection Diesel engines and for cylinder lubrication on hot-head semi-Diesels where water is injected with fuel.


INTERCOOLER
PREVENTS COMPRESSION LOSS AND EXCESSIVE WEAR
DISCHARGE VALVE
DISCHARGE VALVE
CYLINDER OIL INLET
OIL FORMS LUBRICATING FILM THAT MOISTURE WILL NOT WASH AWAY
STRONG LUBRICANT FILM SUPPORTS PISTON WEIGHT, WITHSTANDS PRESSURE
IN HUMID AIR CONDITIONS EXCESSIVE MOISTURE ENTERS INLET VALVES

There is a Calol Product to meet every industrial lubrication problem. For information, write Standard of California, 225 Bush Street, San Francisco 20, California.

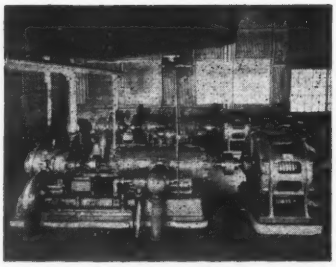
STANDARD OF CALIFORNIA

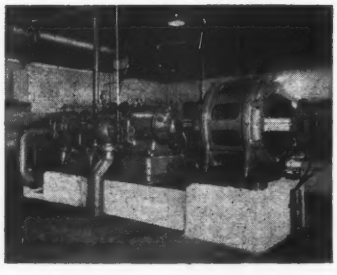
Just see how simple they're built!

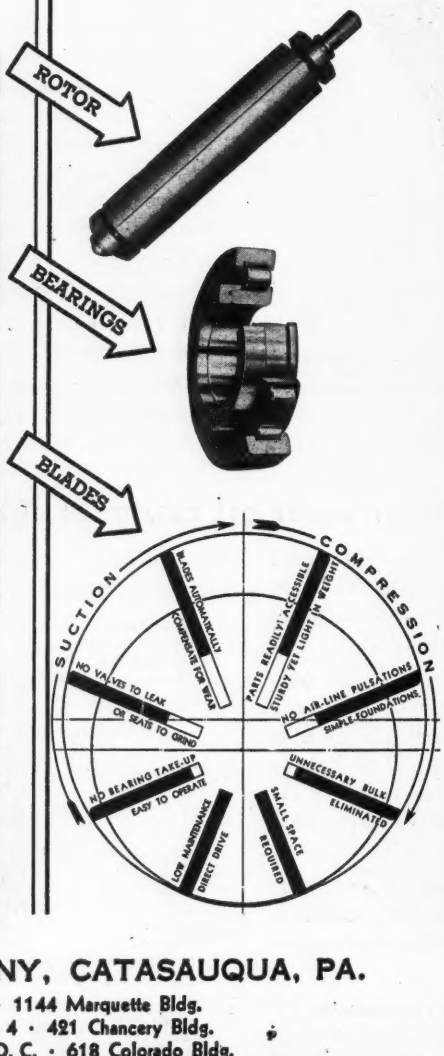
The fewer moving parts that make up any piece of equipment, the more continuous the service at the lowest operating cost. Fullers are an outstanding example of simplicity of design and construction . . . only three moving parts: rotor—bearings—blades.

They show remarkable records of continuous performance and, after long gruelling service, if inspection and check-up is desired, the design permits of easy access with a minimum loss of time.

Write for Bulletin C-5.







FULLER COMPANY, CATASAUQUA, PA.

Chicago 3 · 1144 Marquette Bldg.
San Francisco 4 · 421 Chancery Bldg.
Washington 5, D. C. · 618 Colorado Bldg.

C-120

FULLER

PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

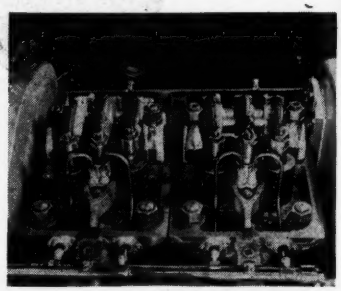
New Equipment

(Continued from page 134)

heat exchanger and is discharged. The fresh water is circulated by a centrifugal pump which passes it first through the oil cooler and thence into the engine water header, which is cast integrally in the side of the cylinder block.

Use of unit fuel pumps and injectors, operating in conjunction with the overhead camshaft, reduces the number of moving parts and makes unnecessary the use of long, high-pressure fuel lines between a separate injector pump and the nozzles. The entire unit-injector assembly can be quickly and easily removed for cleaning and inspection, enabling all servicing to be done under proper bench conditions. A continuous flow of fuel through the injectors serves to keep them cool and to eliminate air locks.

The fuel-control shaft is operated through anti-friction linkage from the governor, with emergency stop



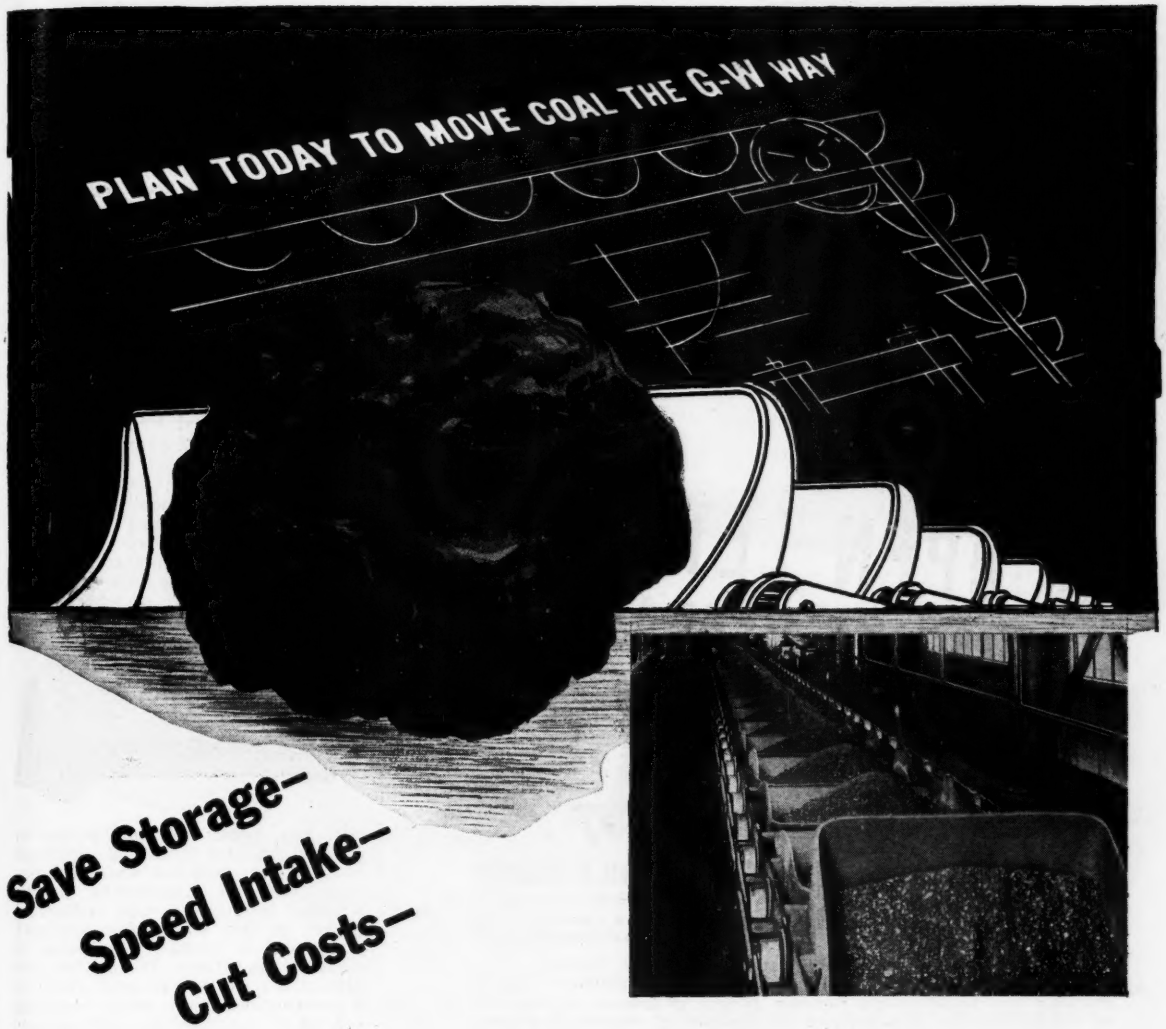
levers located at each end. Injectors are connected individually through spring-loaded linkages which allow the operator to shut off any injector during operation. This spring loading also allows the governor to maintain engine speed through control of the remaining injectors in case one should become inoperative in the open position. Trimmer adjustments permit accurate balancing of cylinder loads. The standard governor is a conventional mechanical fly-ball type of ample size. For installations requiring extremely close speed regulation, governors of the hydraulic type may be furnished.

Optional engine equipment includes clutch power takeoffs, engine-mounted generator, pyrometer and thermocouples, automatic alarm or shutdown equipment, overspeed governor, and on the marine engine, sailing clutch and bilge pump. Series 20 engines are also available as complete electric generating units, or as marine auxiliary units with generator, compressor and pump.

Belt Dressing

A NEW FORMULA liquid belt dressing has been developed by the Graton & Knight Co. research laboratories, Worcester 4, Mass. Although this will be merchandised under the familiar "Grako" trade name, it is a distinctly new liquid dressing.

The most important quality of the belt dressing is its ability to restore power transmission capacity to transmission belts. Repeated tests with



Save Storage—
Speed Intake—
Cut Costs—

There is no longer any question as to whether coal should be received; stored and reclaimed mechanically or manually —it has been answered conclusively in many actual instances ... in favor of mechanical handling equipment.

But there *are* three questions that power men face today in their plans to effect boiler room economies by installing the most practical, reliable, durable, coal handling system. They are ... what is the best layout—what type of equipment should be used—what manufacturer offers dependable, efficient equipment and practical engineering help?

Gifford-Wood is qualified to help you answer these questions. Through specialization in the design, construction and installation of coal and ash storage and handling systems for more than 130 years, G-W can give you an unbiased recommendation on the right types of conveyors, carriers, skip hoists, and elevators, and their best arrangement for meeting your requirements.

Although war activities still have first call on manufacturing facilities, Gifford-Wood's long experience in material handling is at the disposal of your engineering department right now for planning. So when you need a system to move coal in—and move ashes out—plan to do it faster, easier and cheaper..."The G-W Way". Gifford-Wood Co., 420 Lexington Ave., New York 17, N. Y.; 565 W. Washington St., Chicago 6, Ill. Factory—Hudson, N. Y.

DO YOU KNOW? G-W maintains the complete facilities of a well-organized, manufacturing plant ... pattern shop, machine shop, steel, forge, paint and inspection shops ... fully equipped with modern machinery for handling all general contract work.

G-W HANDLES IT Better-Easier-Cheaper

GIFFORD-WOOD

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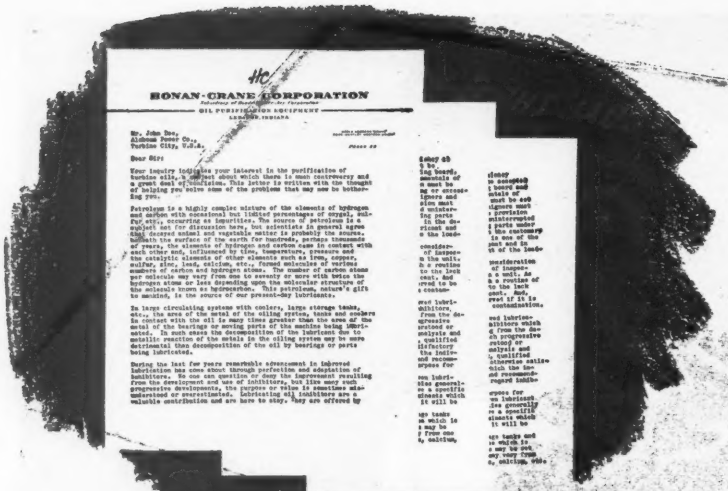

HONAN-CRANE CORPORATION
OIL PURIFICATION EQUIPMENT
LEBANON, INDIANA

Mr. John Doe,
Alabama Power Co.,
Turbine City, Ala.

Dear Sir:

Your inquiry indicates your interest in the purification of turbine oils, a subject about which there is much controversy and a great deal of confusion. This letter is written with the thought of helping you solve some of the problems that may now be bothering you.

Petroleum is a highly complex mixture of the elements of hydrogen and carbon with occasional but limited percentages of oxygen, sulphur etc., occurring as impurities. The source of petroleum is a subject not for discussion here, but scientists in general agree that decayed animal and vegetable matter is probably the source. Beneath the surface of the earth for hundreds, perhaps thousands of years, the elements of hydrogen and carbon came in contact with each other and, influenced by time, temperature, pressure and

AN OPEN LETTER TO TURBINE OPERATORS

THERE IS TODAY much controversy and a great deal of confusion about the use of Fullers Earth for purification of turbine oils containing additives such as rust and oxidation inhibitors.

To clear up this confusion and conflict of opinion, Ben F. Hunter, Honan-Crane Consulting Engineer, has prepared an open letter to turbine operators which answers many of the questions most frequently raised and explains why Fullers Earth should be and CAN BE SATISFACTORILY EMPLOYED ON OILS CONTAINING INHIBITORS. It is yours for the asking.

BEN F. HUNTER
Honan-Crane Corporation
Consulting Engineer

In this three-page, single-spaced letter Mr. Hunter discusses fully and with directness, "rust inhibitors" and "oxidation inhibitors", steam emulsion and neutralization numbers as well as general performance of the turbine. He also explains the function of various inhibitors, what they are, how they work and how they are affected by Fullers Earth purification.

Mr. Hunter, previous to January, 1945, spent 19 years as chief lubrication engineer for the Gulf Oil Corporation and the Gulf Refining Company, and was closely associated with the development of additives in turbine oils.

In his open letter Mr. Hunter answers the questions you—the turbine operator—most frequently ask. His judgment is based on long experience and close contact with the problems of purifying oil containing additives.

● Fill in the coupon below and mail today for your copy of Mr. Hunter's "Open Letter"

HONAN-CRANE CORPORATION
Subsidiary of Houdaille-Hershey Corporation
301 INDIANAPOLIS AVE. LEBANON, INDIANA

Without obligation on my part, please send me Ben F. Hunter's "Open Letter to Turbine Operators."

Name.....

City.....Zone.....State.....

the new Grako show an improvement of 15 to 20 per cent increase in transmission from rating upwards, with a greater percentage rise for belts which are pulling under their rating.

All the oils contained in Grako are nutritive to leather and will greatly prolong its life. Regular use, it is claimed, will keep the belting pliable and glove-like which is necessary for good transmission capacity.

The new Grako pours readily at freezing temperature, 32 F. It is particularly adaptable for conditions where steam and water are bothersome.

Water Heater U-Tube Element

THE AMERICAN DISTRICT STEAM CO., North Tonawanda, N. Y., has announced a new Adsco Instantaneous Type R water heater which is compact in size with a steel shell and 1¼ in. OD No. 16 BWG copper U-tube removable heating element, low friction loss type for use with a gravity recirculation system, or where minimum friction loss in the water space is desirable.

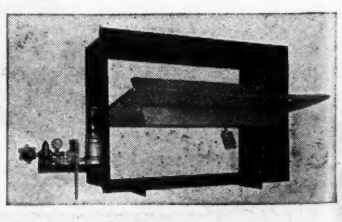
It has numerous applications in commercial and industrial buildings such as providing hot water for domestic use in apartments, hotels, schools, institutions and industrial plants or hot water for process equipment in cooking, sterilizing or cleaning operations. It may be used also as a converter to heat water in a conventional hot water heating system or in connection with radiant heating installations.

Double Damper

ILLUSTRATED HERE is the new double damper smoke control now being manufactured by Campbell Engineering Co., Appleton, Wis., and marketed under the trade mark "Stackmaster." This damper is made in sizes to accommodate the various smoke stacks where it is applied, being designed after an engineering survey of the stack and boiler performance.

It functions to adjust the smoke stack to daily weather conditions in order to eliminate excess smoke, reduce excess stack temperatures, maintain uniform volume of draft and stop combustion fuel losses.

The Stackmaster is installed with either electric, hydraulic, or pneu-



Where conditions of service call for STEEL

. . . in the low pressure range where high temperature, corrosive liquids, fire hazards or need for unusual precaution against leakage or line strains make iron valves impractical—that's where **R-P&C** 150 lb. steel valves and fittings serve best.

READING-PRATT & CADY is especially well-equipped to make these valves, having long specialized on pressure castings of electric furnace steel. Beyond that, **R-P&C** rigid control—from drawing board to final test—assures you of maximum service from every **READING-PRATT & CADY** valve.

The line is extensive, including globes, angles, gates and checks in all the standard pressure classes from 150 lbs. to 1500 lbs.

We suggest that you get a recommendation from **R-P&C** the next time you need valves.

R-P&C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and lubrotite gate valves—bar stock valves—cast steel fittings—d'Este Automatic Valves and Engineering Specialties.

• Valves illustrated are flanged end. All are available with welding end—most with screwed end.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE AUTOMATIC REGULATING VALVES

Reading, Pa. • Atlanta • Boston • Chicago • Denver • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

ACCO

TRADE MARK

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

In Business for Your Safety

What Union has two Bronze Seats ground to a true ball joint?

There's only one answer

DART

Dart's two bronze seats, ground to a true ball joint, distinguish it from all other unions—identify it as the *better* union. It makes a leakproof joint without jamming; thus may be readily disconnected whenever needed on another job. Made of high-test air-refined malleable iron, it is practically indestructible. Call your supplier.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE 5, RHODE ISLAND

matic control so that it may be designed to meet practically all conditions where there are excess smoke and combustion losses.

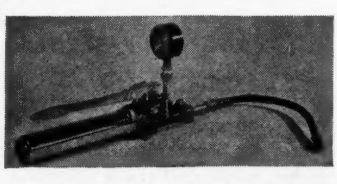
Electrical Wiring Kit

NOW AVAILABLE to industry for general solderless wiring is a new complete electrical wiring kit manufactured by Aircraft-Marine Products, Inc., 15950 North Fourth St., Harrisburg, Pa.

The kit comprises a six purpose precision installation tool which cuts and strips the wire. Also included in the kit is an assortment of 100-amp solderless terminals of the most commonly used types. No soldering is required to make trouble-free electrical connections. Merely insert wire in terminal barrel and crimp with tool.

Pressure Gage Tester

MANSFIELD & GREEN, Cleveland, O., has developed a new multi-purpose pressure gage tester which combines in a single unit a pressure gage tester that can be used with equal facility for bench testing and for portable testing in the field. On bench testing, the unit can be used with test gages or with a dead weight attachment.



A simple, doubly sealed check valve, eliminates leakage and loss of pressure even with grit in the system, whether using oil or water and for pressures up to 10,000 psi.

Principal uses of the testing unit include testing and repairing of pressure gages and instruments, the setting of relief or other pressure actuated valves and general hydrostatic testing.

Cleaning Agent

A NEW "PICKLING" AGENT to remove rust, scale, tarnish, and incrustations of cement and lime from metals is being marketed by Waverly Petroleum Products Co., Drexel Bldg., Philadelphia 6, Pa. Troxide, as this new chemical is named, is a dry, inert compound. It is non-eruptive, non-inflammable, and is said to present

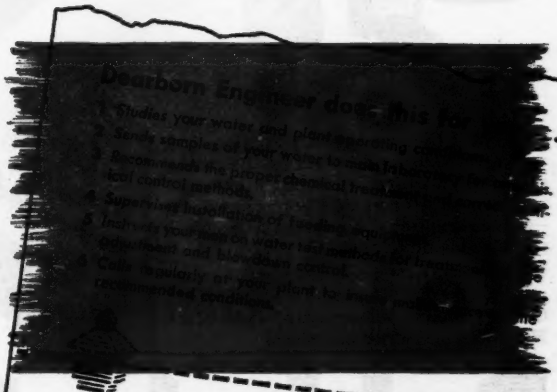
Boiler Room Trouble Shooter in Action . . .

When you call the Dearborn Engineer to take the trouble out of boiler water, he "gets down to cases". . . right in your boiler room. He comes to you with the experience and background of a boiler water expert.

First, he makes an analysis of the troublesome feedwater; identifies what is causing your boilers to foam, scale, or corrode; and takes steps to stop these harmful activities.

Meanwhile, wires are hot and mails are busy as he maintains constant contact between your plant and the Dearborn main laboratories. Here, there is a hum of activity as they double-check the data he forwards to them. Here, too, a special treatment is formulated that will neutralize trouble makers and assure boilers of good steaming capacity and extended operation.

Your Dearborn Engineer knows local water characteristics. That's why he can not only assist you in an emergency but establish a routine that minimizes trouble. Call him . . . or write to us direct.

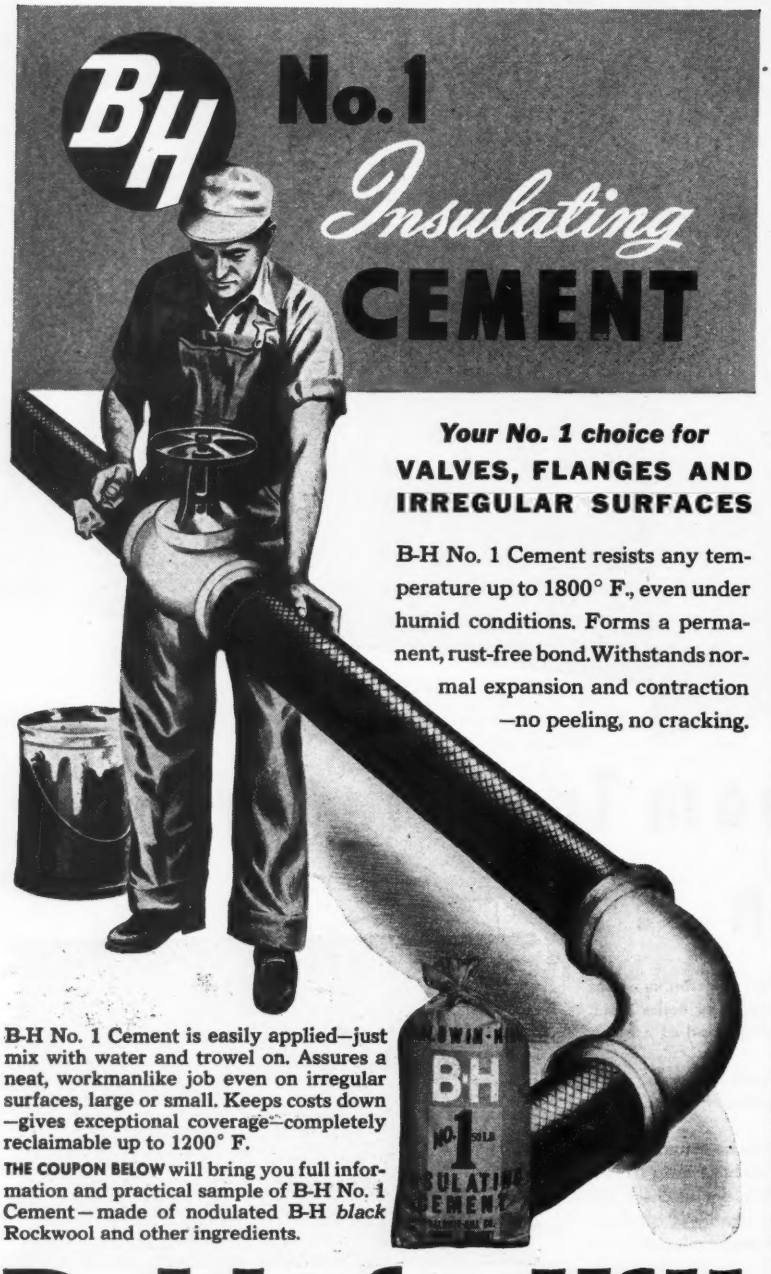


Dearborn
TRADE MARK REGISTERED

WATER TREATMENT AND ENGINEERING SERVICE

THE LEADER FOR OVER HALF A CENTURY

DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Ave., Chicago 4, Ill.



Your No. 1 choice for

VALVES, FLANGES AND IRREGULAR SURFACES

B-H No. 1 Cement resists any temperature up to 1800° F., even under humid conditions. Forms a permanent, rust-free bond. Withstands normal expansion and contraction —no peeling, no cracking.

B-H No. 1 Cement is easily applied—just mix with water and trowel on. Assures a neat, workmanlike job even on irregular surfaces, large or small. Keeps costs down —gives exceptional coverage—completely reclaimable up to 1200° F.

THE COUPON BELOW will bring you full information and practical sample of B-H No. 1 Cement—made of nodulated B-H *black* Rockwool and other ingredients.

Baldwin-Hill

THERMAL INSULATION PRODUCTS

Baldwin-Hill Co., 514 Klagg Ave., Trenton 2, N. J.

Send information on products checked below:

☐ Free sample of B-H No. 1 Cement

☐ No. 100 Pipe Covering—effective up to 1200° F. (for long runs overhead, underground, Diesel exhausts)

☐ Mono-Block—the one-block insulation for all temperatures up to 1700° F.

☐ Black Rockwool Blankets (felted between various types of metal fabrics)

NAME _____ POSITION _____

FIRM _____

ADDRESS _____

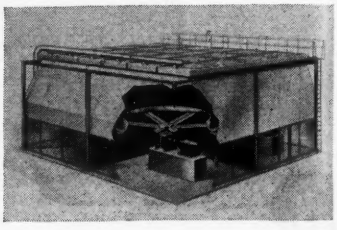
CITY _____ ZONE _____ STATE _____

none of the occupational hazards common to acids heretofore used in pickling.

It is claimed that Troxide throws off no "acid-mist" or other toxic fumes which are pungent, corrosive, and harmful to workmen and machinery. Tests prove that troxide attacks the scale, not the good metal, and the surfaces are left smooth, clean, and bright; thus, the hazards of over-pickling are materially reduced.

Cooling Unit

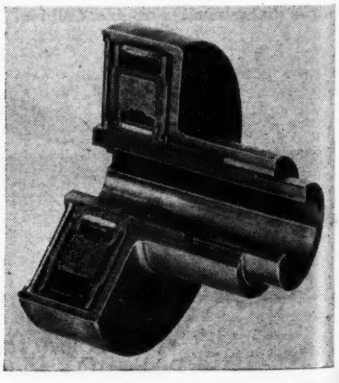
THE FLUOR CORP., LTD., 2500 South Atlantic Blvd., Los Angeles 22, Calif., has developed cooling sections employing the highly efficient K-fin tube construction which are cooled by forced draft fed by air from the cooler layer at ground level and supplied by fans with variable pitch blades and with variable speed drive. Vertical



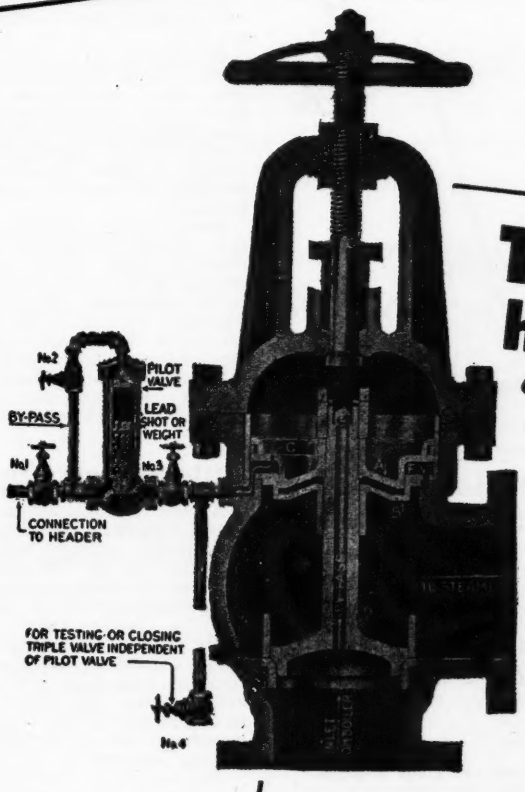
air flow against static head assures even air distribution over cooling surfaces. Fin Fan Units are designed for pressures to 5000 psi and temperatures to 1500 F. Coils are located to provide sufficient static head for pump suction. Tubes can be removed and replaced quickly and all mechanical equipment is readily accessible from the ground.

Mercury Clutch

MERCURY CLUTCH CORP., Canton, O., has developed a mercury clutch which in its simplest form consists of a drum-like member attached to the power source, containing a small quantity of mercury confined in a narrow annular space. When this drum is revolved, the centrifugal force, varying as the square of the speed, urges the mercury outwardly and the pressure created acts directly on the friction members, bringing them into contact with a drum attached to the load. Only a small



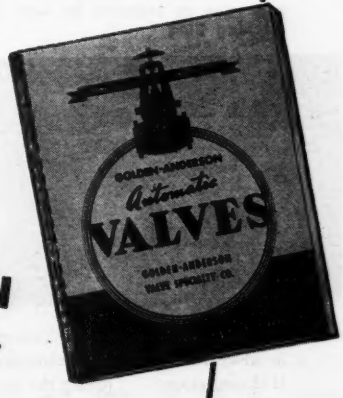
Ever think what a line rupture might do to your plant?



This Valve will help you out of "Tight Spots"

We don't say that steam lines *will* rupture in your plant—but should that happen it would mean a serious loss in time and production. You can insure yourself against that possibility by installing the GOLDEN-ANDERSON Triple Acting Non Return Valve illustrated here. It's designed to prevent burst steam lines by automatically cutting in the boiler at the instant boiler pressure equals lineheader pressure . . . and to isolate or cut off the flow of steam whenever boiler pressure falls below line header pressure. Further, this valve stops the flow of steam from the boiler in case line header pressure drops suddenly.

Complete information . . . operating and construction diagrams plus full descriptions . . . on this and all GOLDEN-ANDERSON Specialty Valves is contained in our catalog. Write for your copy.



GOLDEN-ANDERSON
Valve Specialty Co.
1300 FULTON BLDG.
Pittsburgh Pa.

Greater Flexibility in Alignment of Pipes . . . Valves . . . Fittings

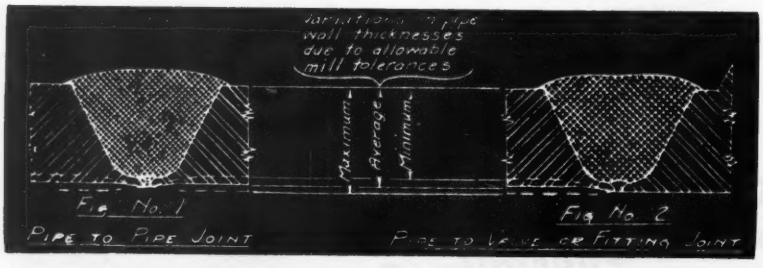
WHEN YOU USE THE WESTPORT WELDED JOINT

Yes, you get GREATER FLEXIBILITY when your pipes are welded by the Westport Patented Joint . . . because with this method the fusion buttwelded joints are made from one side only . . . with complete penetration to the root of the weld . . . and there are NO icicles or protrusions at the base of the weld!

When you engage Mitchell & Co. you are assured of getting fabricated piping with the latest in Power piping design, which includes the Westport Welded Joint.

Features of the joint include:

1. **No constriction in pipe area due to Backing Rings**
2. **Smooth Pipe contour at base of weld**
3. **No sacrifice in strength of the pipe due to removal of wall or Backing Ring**
4. **No gaps between rings and the inside of the pipe wall**
5. **Uniform physical properties**
6. **Meets A.S.M.E. Standards.**



The Westport Method . . . illustrated above . . . consists of the use of a joint in which the ends to be welded are formed and machined to provide a special U-shaped groove . . . joining the lips at the roof of the weld by the oxyacetylene process . . . and completing the joint by the usual electric arc procedure.

WRITE FOR BULLETIN AND FULL DETAILS

W. K. MITCHELL & CO., INC.

PHILADELPHIA 46, PENNA.

1899 — 1945

quantity of mercury is required since the hydraulic pressure created by the "head" of mercury is quite independent of the total weight of the mercury. Therefore, a mercury clutch is much smaller and lighter than any centrifugal clutch using weights.

In the large clutches, axial pressure and multiple disc friction elements are used.

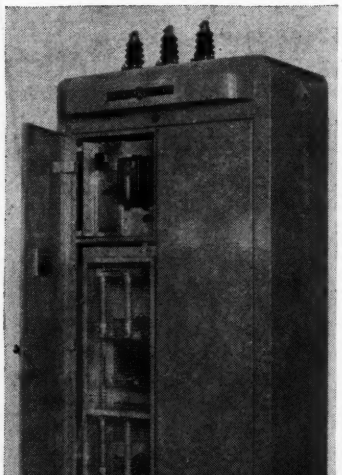
In addition to the primary mercury control which is automatic in its action, other controls are utilized to meet specific conditions. Spring pressure, acting against the mercury, provides delayed engagement. Several types of auxiliary manual controls are available and remote control may be provided.

Among other advantages, the mercury clutch can permit heavy mechanical loads to be started with smaller power sources than when directly connected, start loads from a standstill without shock or jolt and accelerate loads smoothly, provide overload protection permit no-load idling of internal combustion engines, serve as automatic over-speed brake, and absorb shock loads.

Auto-Switch Capacitors

A NEW METAL-ENCLOSED, self-contained auto-switch capacitor, that automatically switches 180-kva of capacitance on or off the feeder in response to voltage requirements, has been announced by the General Electric Co., Schenectady, New York. Designed for improving the power factor of distribution circuits at periods of peak load, the capacitor is automatically connected in the circuit where increased load causes a drop in voltage, and is disconnected when voltage increases at light load.

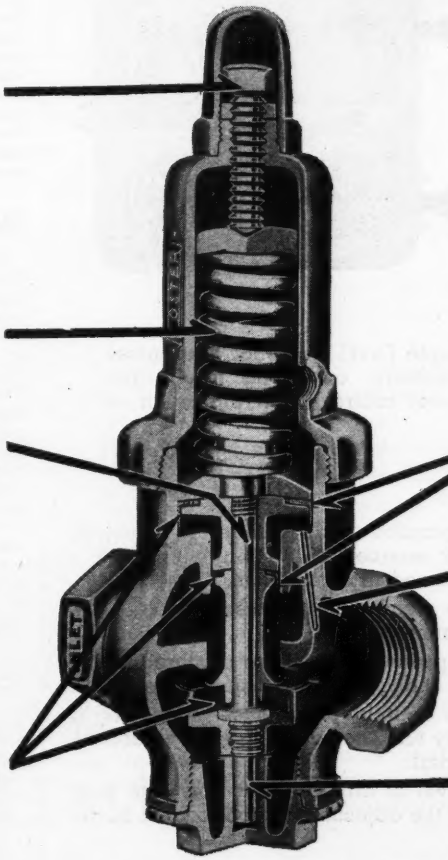
The equipment consists of a 180-kva, 2400-v delta or 4160-v 4-wire or Gr Y, three-phase group of Pyranol capacitor units, a three-pole solenoid-operated oil switch, automatic voltage control devices, and a potential trans-



FOSTER REGULATION ENGINEERING

Saves Maintenance Time

for example, **in this direct-acting valve for water or air services, the Foster Type U gives you regulation without complication.**



1 Easily set under pressure

2 Springs "flexible" cadmium plated

3 Stems, special high-tensile bronze to minimize stretch from pressure shock

4 Soft disc and leather sealing cups renewable

5 Leathers impregnated with special lubricant.

6 Moving seals, leather-to-bronze

7 Ports straight drilled, self-cleaning

8 Bronze guides

Foster Type U, Spring-loaded Direct-acting Reducing Valve for Water and Air Service

Foster Regulation Engineering, built into each valve, is your assurance of years of accurate, trouble free operation

★ **BUY MORE BONDS** ★

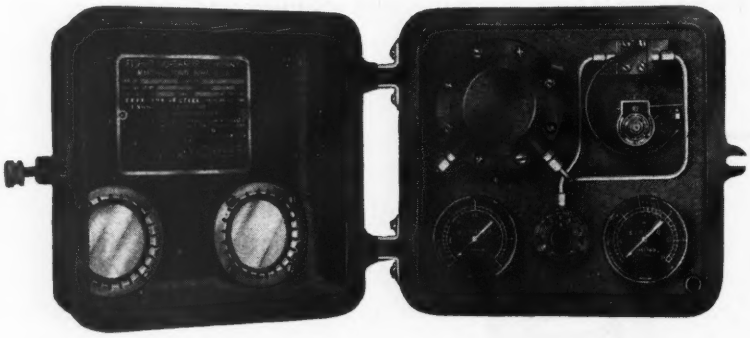
FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS... PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

111 MONROE STREET • NEWARK 1, N. J.

T-FE-2

100% PNEUMATIC PILOT OPERATION IS AN EXCLUSIVE LEVEL-TROL FEATURE



The unique, mechanically simple Level-Trol pilot guarantees maximum sensitivity, dependability, and long trouble-free service whether applied to level control, level indication or interface level control.

(1) It is 100% pneumatic in its operation — all linkage, pivot points, sliding adjustments and other sources of friction eliminated — necessary operating power reduced to a minimum.

(2) Minimum of moving parts to wear out or cause trouble — dependable, trouble-free performance assured.

(3) Intermittent bleed pilot relay speeds action of the diaphragm control valve in response to level change — no measurable lag.

(4) Throttling range adjustment is entirely pneumatic — no gears or sliding levers to adjust — simply turn the adjusting knob in accordance with calibrations on the dial.

(5) Likewise the position of the level at any constant flow rate may be readily adjusted by turning the adjustment knob located in the center of the Bourdon tube.

Type 2400-248, 600 lb. electric cast steel float cage.

Level-Trols are available in a wide range of types and sizes for all fluids and all applications. Write for Bulletin F-1.

FISHER GOVERNOR COMPANY
1027 Fisher Bldg., MARSHALLTOWN, IOWA

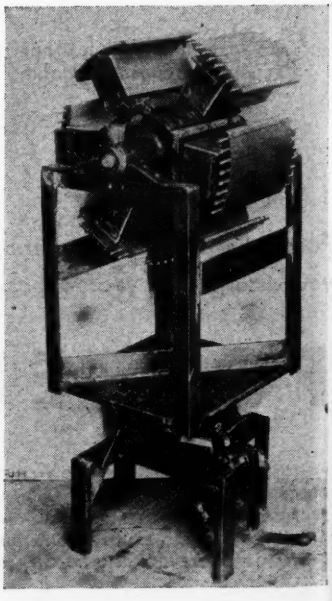
former for supplying control power, as well as control potential for voltage-responsive equipments. Although the standard equipment is designed for response to line voltage, current-responsive equipments are also available.

The housing is designed for base or cross-arm mounting. Cover bushings of wet-process porcelain with clamp-terminal connectors provide for easy connection to the line. A hinged panel, containing all the devices for both automatic and manual control, is mounted in a protective compartment which separates the control from the power circuits. A protective screen prevents accidental contact with live bus work while working on this panel. An electric interlock automatically disconnects the equipment from the line when the protective screen is opened for access to the capacitor units or fuses. A red signal lamp remains lighted while the oil switch is closed and the capacitors are connected to the line. The whole unit is about 8 ft 7½ in. in height, 46 in. wide, and 26 in. in breadth, and weights 1420 lb.

Welding Positioner

DATA AND PHOTO furnished by the Hobart Brothers Co., Troy, O., describe a positioning fixture suggestion by John Wannow, consisting of a square frame, supporting the rotor of a power generating unit, to weld end rings on the assembled rotors. The fixture can be rotated on its vertical axis and is controlled by a foot pedal. A small quick pressure on the pedal will cause rotation of the vertical axis and a catch is provided so that each kick on the pedal limits the rotation to 180.

Mr. Wannow also conceived the idea of building up "dummy" spiders with oversize dovetailed slots to give a loose fit with dovetails of the poles. Poles with cage to be welded can be easily mounted on the "dummy" spider and "dummy" rotor and poles can be rotated about either a horizontal or vertical axis to provide the

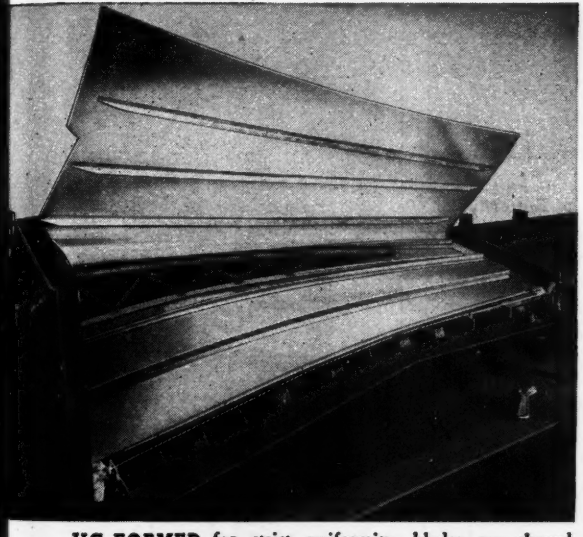


FAN FEATURES

that contribute to the economy and efficiency of

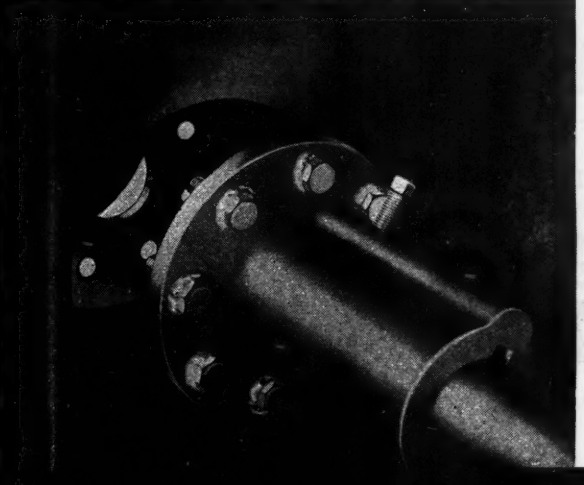
Pritchard COOLING TOWERS

DYNAMIC BALANCING is standard procedure in the production of Pritchard Featherweight Fans. Test apparatus includes this rig using an electronic balance indicator.



JIG FORMED for strict uniformity, blades are shaped from a single heavy wrought monel sheet with the trailing edge electric-welded. Note the welded-in "wing spar" and stiffening webs for staunch rigidity and endurance.

HUB SLEEVE on fan shaft provides key and set screw locking, yet permits removal of the fan assembly without driving the sleeve off the fan shaft.



Here are a few of the reasons why Pritchard FEATHERWEIGHT Fans are acclaimed by operators as the optimum answer to cooling tower fan problems:

1. LIGHT WEIGHT for low starting torque, minimum vibrational reaction and low loading on fan shaft bearings.
2. MONEL METAL BLADES for corrosion resistance and maximum delivery of air in ratio to horsepower.
3. ANTI-BACK-DRAFT HUB for streamlined flow of air; no turbulence or air return.
4. TRUE AIR-FOIL SECTION of blade equalizes air propulsion over full length of each blade. Practically noiseless in operation, with high efficiency at low tip speeds.
5. ADJUSTABLE BLADE PITCH permits selection of most desirable setting for any tower loading.
6. HUB SLEEVE (see lower left) permits easy removal of fan for winter operation and also makes quick work of removing the gear unit for servicing.

Continuous trouble-free performance over more than five years demonstrates the advantages of Pritchard's patented design and features, the result of comprehensive research to minimize power requirements, reduce maintenance and extend the life of mechanical draft equipment. These proven units are easily installed as replacements for obsolete, inefficient fan assemblies. They will pay for themselves quickly in savings of power, maintenance and down-time.

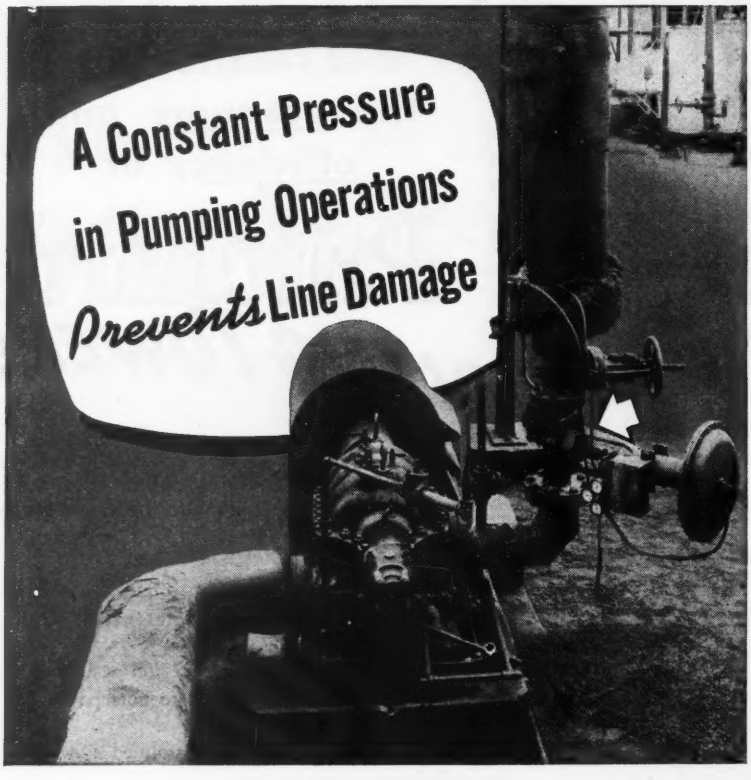
EQUIPMENT DIVISION

J.F. Pritchard & Co.

ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES

FIDELITY BUILDING, KANSAS CITY 6, MO.

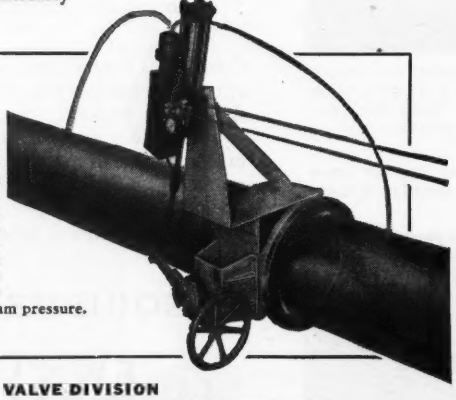
NEW YORK - PITTSBURGH - HOUSTON - ATLANTA - TULSA
DENVER - SALT LAKE CITY - EL PASO - OMAHA



The upstream or downstream pressure in a line can be controlled automatically by an R-S Butterfly Valve, equipped with an air diaphragm, oil or hydraulic positioner cylinder attached to the valve. If the line pressure decreases, the valve vane slowly closes until the predetermined line pressure has been reached, at which time the vane automatically reopens.

The use of an R-S Butterfly Valve as a main control valve provides unexcelled flow characteristics, simplifies performance, prevents water hammer and reduces maintenance. Operates for pressures between absolute and 900 pounds gauge.

Write for Catalog No. 14-B.



No. 501

125-pound American Standard R-S Valve equipped with declutching unit (patent applied for) which permits operation of the valve with the hand wheel. Only four to six revolutions of the hand wheel are required for complete opening or closure. The dotted lines indicate the piping necessary to maintain a constant upstream pressure.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Avenue • Philadelphia 44, Pa.

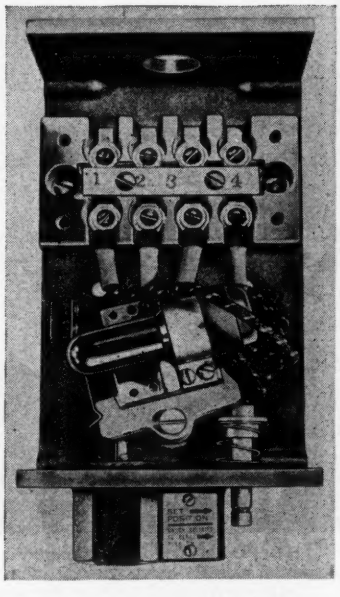
R-S Streamlined BUTTERFLY VALVES

best position for welding. In addition to positioning for cage welding this device can be used for some of the welding operations for reinforcing the coil support shelf on the pole ends.

Production has been increased because the time to position the poles is much less than by the old method, which consisted of blocking up individual poles on a work bench, and because the welder can do the positioning without putting down his welding equipment.

Pressure Switch

THE KIDDE PRESSURE SWITCH is an accessory device developed by Walter Kidde & Co., Inc., 40 East 34th Street, New York 16, N. Y., for use with built-in carbon dioxide fire extinguishing systems. It assists in isolating the fire by automatically cutting off electrical circuits in fans, blowers or other electrical equipment when the extinguishing system operates. It is a self-contained, mercury contact-type switch suitable for applications which employ gas or air pressure.



The pressure switch is connected by a bleed pipe from the main distribution line and is operated by the carbon dioxide in passing through this distributing piping to the discharge nozzles. The gas pressure actuates a plunger which trips the breaker arm of the switch, opening or closing the circuits desired. The device is available for control of two, three or four circuits, each of which may be wired for normally open or normally closed operation. The pressure switch is provided with a manual reset to restore circuits to their original position after operation due to fire.

Wire Belt Hooks

THE BRISTOL CO., Waterbury 91, Conn., recently announced the addition of a line of hinged-type wire belt hooks, known as Bristol's Belt Hooks, to its line of belt lacing prod-

YOU'LL WANT THESE ADVANTAGES OF

LIMITORQUE CONTROLS

IN YOUR PLANS FOR THE FUTURE . . .

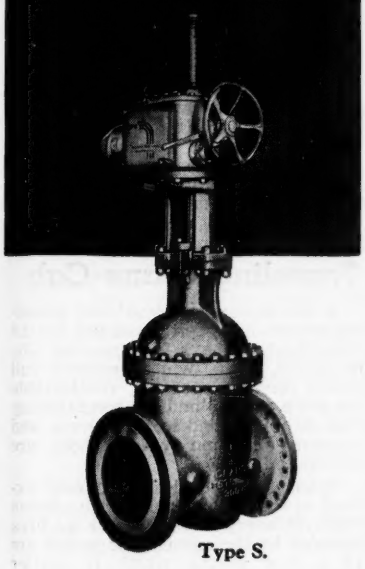
1...DEPENDABILITY

UNDER ALL CONDITIONS

2...EASE OF OPERATION

The outstanding dependability of LimiTorque Controls is important for two reasons . . . it assures unfailing operation of valves, sluice gates or similar equipment under any condition and also assures a great saving in maintenance. Reports from many central stations, power plants, etc. where LimiTorque Controls have been installed indicate they require practically no maintenance.

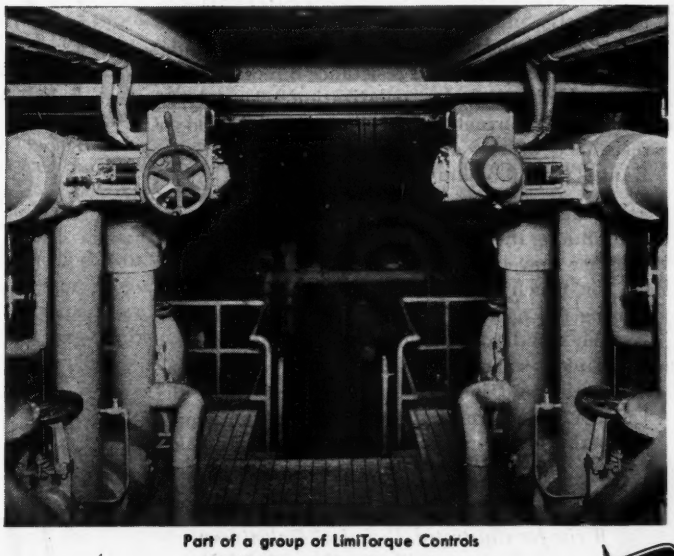
LimiTorque is extremely simple to actuate . . . just by pushing a button at a conveniently located push-button station or a master control panel, valves up to 96" diameter may be opened or closed. It makes remote valve control practical from one central point with a full knowledge of the status of valves at all times.



Type S.

Several types of LimiTorque Controls are available for varied requirements on all types and makes of valves . . . also they can be adapted to existing equipment. Where it is not practical to fit the controls directly to the valve yokes, floor stands can be provided.

In your plans for post-war new construction or the modernization of present plants, include LimiTorque Controls. We'll gladly supply full details.

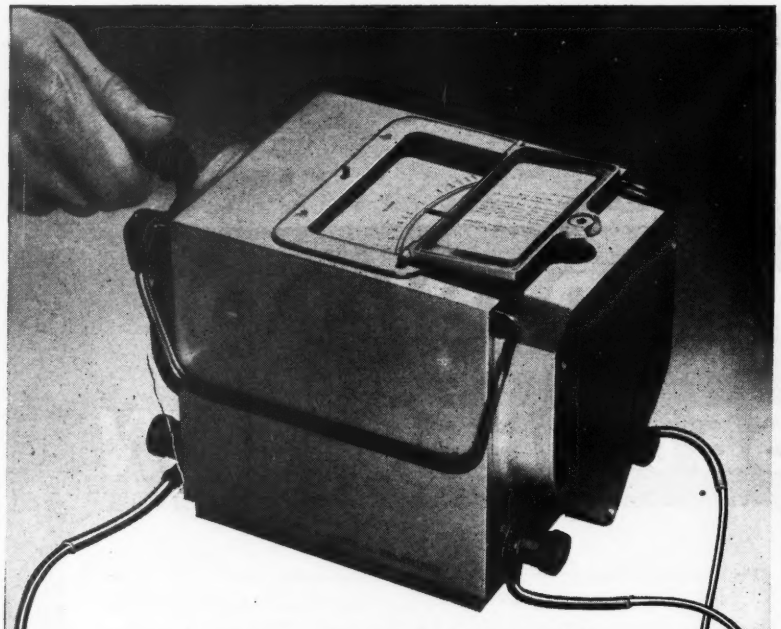


Part of a group of LimiTorque Controls installed in a hydro-electric plant.

Philadelphia GEAR WORKS INCORPORATED

ERIE AVE. AND G ST., PHILADELPHIA 34, PA. NEW YORK · PITTSBURGH · CHICAGO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls



"MEGGER"*
GROUND TESTER

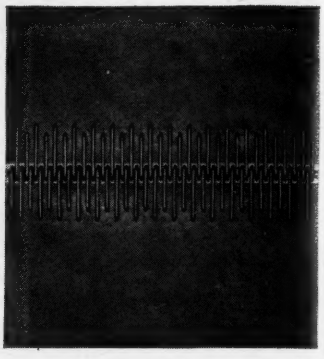
The "Megger" Ground Tester measures resistance to earth of ground connections, quickly, easily and accurately. Simply connect the instrument to the installed ground and to two reference grounds, turn the crank and read resistance directly on the scale. Unaffected by polarization, electrolysis, stray earth currents or by the exact location or resistance of the auxiliary ground connections. Ranges from 0-3 ohms to 0-30,000 ohms.

"Megger" Ground Testers are invaluable for determining the nature of ground connections, and whether they are in condition to perform the service for which they are designed and installed. During the past 15 years these instruments have become standard equipment among many power companies, railroads, telegraph and telephone companies and industrial plants throughout the U. S. A. They are as rugged, reliable and simple in operation for ground resistance measurements as are our "Megger" instruments for testing insulation.

Write for illustrated Technical Bulletin on Ground Resistance Testers No. 1285-PE.

*Trademark Reg. U. S. Pat. Off.

JAMES G. BIDDLE CO. · 1211-13 ARCH ST. PHILA. 7, PA.



ucts. The new hooks are designed for joining all types of flat belting, including leather, fabric, rubber, and balata belts. Various sizes are offered to take care of belts up to ⅝ in. thick.

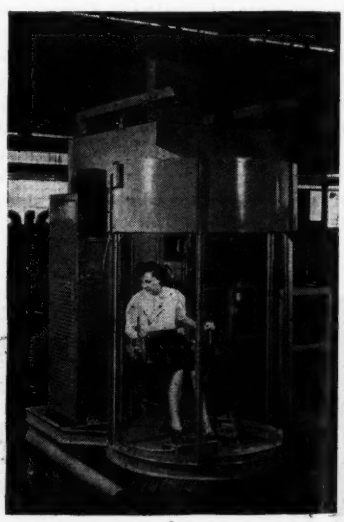
A new method of mounting the hooks in the spacer card makes it possible to leave the card in place in the lacing machine during the lacing operation. The hooks are thus held in accurate alinement until the hook points pierce the belt.

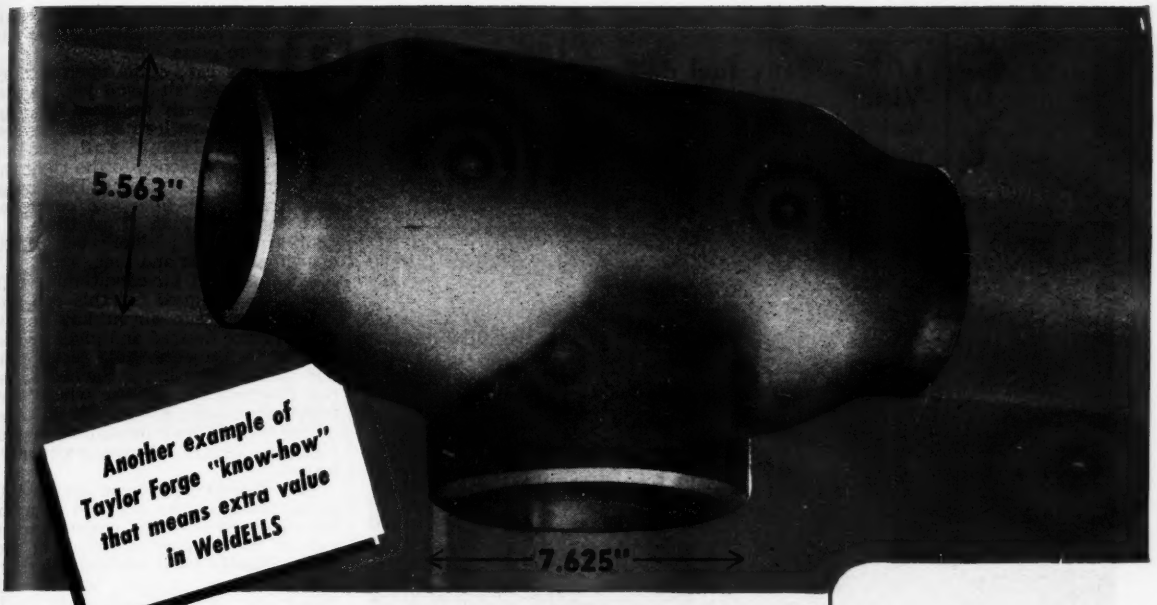
The hooks are designed in such a way as to enter the belt in two rows with each opposite point passing into the belt in alternate rows. The purpose of this arrangement is to eliminate interference between opposite hook points as they are pressed into place and also to distribute the grip on the end of the belt over a greater area.

Traveling Crane Cab

A CAB DESIGN FOR overhead traveling cranes has been developed by the Cleveland Crane & Engineering Co., Wickliffe, Ohio, which includes full vision for the operator, comfortable sit-down control and air conditioning. The cab is cylindrical in shape and corners or blind vision spots are eliminated.

Transparent enclosure panels extend to the floor permitting maximum vision in every direction over the area covered by the crane. The panels are of a new plastic which is shatter





Another example of Taylor Forge "know-how" that means extra value in WeldELLS

Tail wags dog—

★ *This is the first time we ever made this odd size-combination of welding tees larger in the branch than in the run. They are seamless carbon-moly forgings with a seven-inch branch, but only five inches in the run—a sort of tail-wags-dog idea called for by a peculiar set of conditions.*

However, this is definitely not the first time, or even the thousandth time, that we have been called upon to solve an unusual, first-time, forging problem like this. It is simply typical of hundreds of special—often extremely difficult—problems turned over to us by engineers who respect the Taylor Forge reputation for "meeting all comers" and licking most of them.

DO NOT underestimate the influence of this broad experience on our standard line of WeldELLS and other Taylor Forge Welding Fittings. It is the sound, practical kind of experience acquired in handling just about every conceivable kind of forging problem in the piping field . . . and it was full grown long before welding fittings were ever produced on a commercial scale!

Thus, in developing WeldELLS we did not have to ask what kind of fitting is easiest to manufacture. Instead we could ask what comprises the ideal fitting, and then, with every special facility and process at our command, make that ideal a reality.

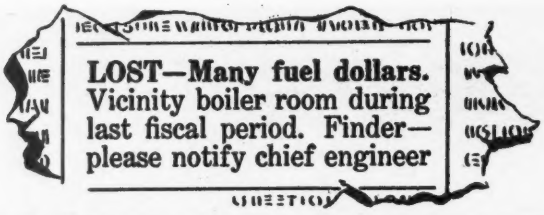
That is why WeldELLS alone combine the features listed opposite . . . why they have extra metal distributed where stresses are greatest . . . why they have such extremely accurate dimensions . . . why they have tangents and those "convenience" features which speed up welding and cut costs. That is why, in short

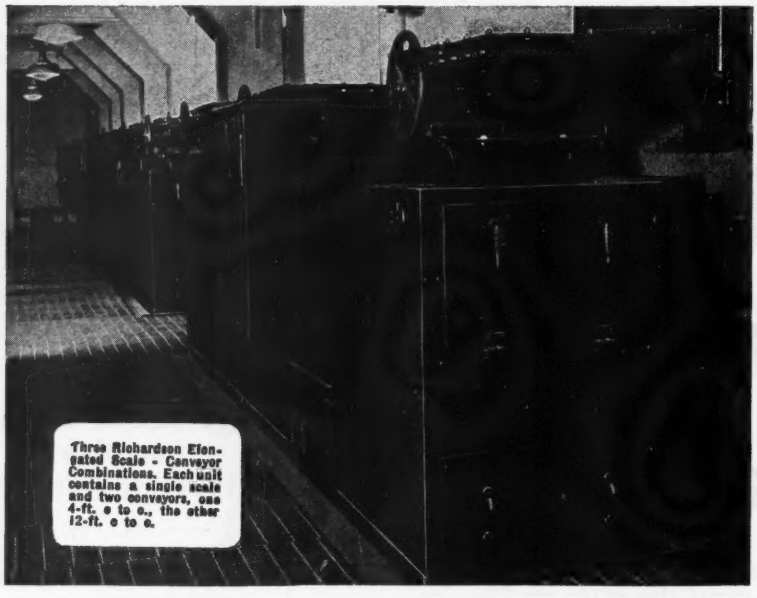
WeldELLS alone combine these features:

- **Seamless**—greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking** — saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Building




Three Richardson Elongated Scale - Conveyor Combinations. Each unit contains a single scale and two conveyors, one 4-ft. c to c., the other 12-ft. c to c.

Coal Losses Cannot Be Recovered —They Must Be PREVENTED

Dollars lost through inefficient coal consumption are lost forever! Guard against wasting YOUR fuel dollars by installing Richardson Automatic Coal Scales. The Richardson coal weighing and feeding system will spot the coal-wasting boilers before losses become serious.

A complete Richardson installation consists of: *Gate* from the bunker; flexible *Inlet* to scale; the *Automatic Coal Scale;* and *Monorate Distributor* to stoker, or down-take *Chute* to pulverizer. By distributing coal evenly across stoker hopper without *segregation* the Monorate Distributor greatly increases combustion efficiency.

The Richardson line of *Automatic Coal Scales* includes: Stationary floor-mounted models, stationary and portable models mounted at mid-section, and combination Conveyor and elongated Scale. The Elongated Model illustrated is of special interest where headroom is limited, where coal is fed from as many as five bunker outlets located as much as 35 ft. apart.

Full details on the complete Richardson system of coal control economy are available in Bulletin No. 1143, yours on request. Write for it today.

RICHARDSON SCALE CO.

CLIFTON, N. J.

Atlanta • Boston • Chicago • Omaha • Montreal • New York • Philadelphia Minneapolis • Detroit • San Francisco • Toronto • Wichita • Pittsburgh

7610

proof and impervious to certain gases common in many plants that may be injurious to glass.

With this cab, crane operation becomes an easy, sit-down job. Master switches especially designed for magnetic control are located for greatest convenience. Hoist and trolley switches are attached to the right and left arms of the chair. The bridge switch is on the floor and controlled with the right foot. Thus there is a definite control job for each of the operator's hands and feet.

An air-cooled air-conditioning unit, especially designed for this cab provides fresh clean air at any normal temperature desired and gives protection against objectionable gases, dusts and fumes. The unit attached to the cab illustrated is for use where temperatures do not exceed 140 F. Adequate sealing and insulation is provided to assure against excessive losses.

The traveling platform serves both as vestibule to the cab and a means for easy access to the entire exterior side of the window for cleaning purposes. Safety locks on both platform and cab door prevent operation of either except when platform is in proper position.

This new cab is a self-contained unit that may be furnished with any new crane employing magnetic control and it may be applied to existing cranes of any make.

Obituaries

W. A. Russell

AFTER AN ILLNESS of several months, W. A. Russel, second vice president of the American Society of Heating and Ventilating Engineers, died on Saturday, May 12, at the Osteopathic Hospital, Kansas City, Mo.

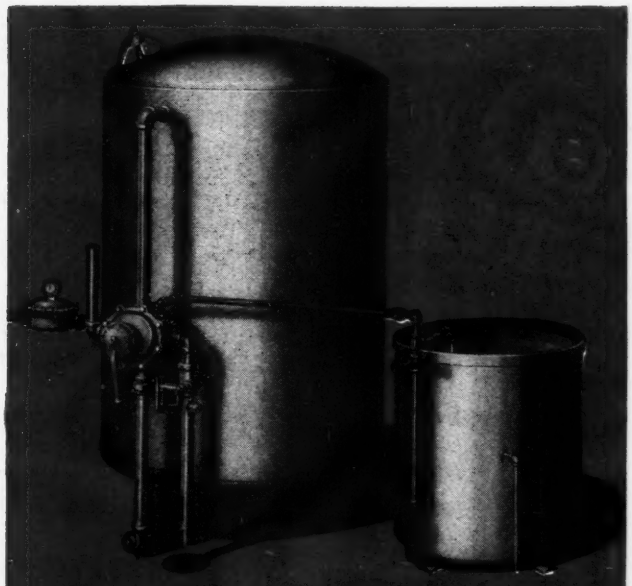
Born in Chicago in 1886, Mr. Russell was graduated from the University High School, Chicago, and from the University of Michigan, Ann Arbor. Following his graduation he spent two years as superintendent of construction for the Central Manufacturing District in Chicago. Later he became associated with Spencer Heater Co., Chicago, as boiler salesman. After four years he joined the staff of the Mine & Smelter Supply Co., Denver, Colo., where he furthered the sale of products of the U. S. Radiator Corp. In 1921, when he joined the ASHAVE, he became manager of the Kansas City branch office of the United States Radiator Corp.

At the time of his death, Mr. Russell was district manager for the Hoffman Specialty Co., with headquarters in Kansas City. He was a member of the fuel oil panel of the war price and rationing board of Kansas City since its inception three years ago.

Mr. Russell took an active interest in Society affairs for nearly a quarter of a century, serving as a member of the Council over a period of nine years. He took great pride in inter-

7 features

NO OTHER WATER SOFTENER CAN MATCH!



Latest design Elgin Water Softener

1 DELIVERS 44% MORE SOFT WATER
In comparison with other zeolite water softeners the Elgin delivers as much as 44% more soft water.

2 LOWER INVESTMENT
Based on cost per thousand gallons of soft water delivered, the Elgin Water Softener is far lower in price.

3 LOWER OPERATING COST
By virtue of an improved distributing and collecting system, less regenerating salt and wash water are required.

4 HIGHER EFFICIENCY
The water softening zeolite in the Elgin is kept clean and active so that equipment operates more efficiently without attention—and more "zero-soft" water is delivered per pound of salt used.

5 LESS MAINTENANCE
Unbiased surveys prove that with ELGIN quality construction throughout, fewer replacements are required. Loss of zeolite is prevented, thus eliminating costly additions.

6 LONGER LIFE
Efficient distribution, collection and regulation of water and brine add years to the life of Elgin Water Softeners.

7 LESS SPACE REQUIRED
To give the same capacity as an Elgin, other water softeners must be as much as 50% larger in size.

WHY THE ELGIN GIVES GREATER CAPACITY AND HIGHER EFFICIENCY

There is nothing mysterious about the increased soft water output and the higher efficiency of the Elgin Water Softener. It simply accommodates a far greater quantity of water softening zeolite and uses it more effectively by virtue of an ingenious manifold system and backwash regulator. Naturally a greater volume of soft water is delivered because it's the zeolite that softens water—and more zeolite used with greater effectiveness means more softened water. Add to this the outstanding quality and the high capacity feature of Elgin water softening zeolite and you have the whole story in a nutshell.

Bulletin 603 gives all the facts. Write for your copy today.

Existing water softeners of any make can be modernized by Elgin to provide the above features.

ELGIN SOFTENER CORPORATION

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING

HENSZEY FLOW INDICATOR

To know the rate of flow at any one instant, at any time, requires a flow indicator that is accurate and easy to read — like the Henszey Flow Indicator. This rugged instrument goes right in the line and indicates the flow accurately from zero to 100 per cent — indicating a pulsating flow exactly as it occurs.

With only three moving parts, the Henszey Flow Indicator stays on the job — breakdowns due to complicated mechanisms and gears are eliminated.

Henszey Flow Indicators are satisfactorily performing in nationally known paper mills, chemical plants, petroleum refineries, milk condenseries and other vitally important industries.

Send for Bulletin FI-1

HENSZEY CO. Dept. C7 Watertown, Wis.

HENSZEY

FLOW INDICATORS

Continuous Blowdown ● Distillation Systems ● Heat Exchangers
Feed Water Meters ● Boiler Feed Regulators ● Proportioning Valves

esting new members in Society membership, and he served as a member of its Membership Committee for over seven years, and an additional two years as chairman of this committee. As one of the most active members of the Kansas City Chapter, he served as its treasurer in 1921-22; as its vice president in both 1923 and 1931; as secretary in 1930; as its president in 1932, and as a member of its board of governors in 1933. In 1934, 1940 and 1941 he was the representative of the Kansas City Chapter on the nominating committee of the Society, and in 1935 and 1942 was the alternate. At the time of his death he was serving the Society as its second vice president.

C. Walter Spalding

C. WALTER SPALDING, manager, power transmission machinery of Link-Belt Co. died on May 25 in Chicago, Ill. Mr. Spalding, whose headquarters were at the company's Ewart plant in Indianapolis, began his Link-Belt career in 1910 at Indianapolis. He is a veteran of World War No. I. Mr. Spalding is survived by Mrs. Spalding, a son and a daughter. His son is a Lieutenant in the Army Air Corps.

MANUFACTURERS' *News*

Change in Morse Chain Co. Organization

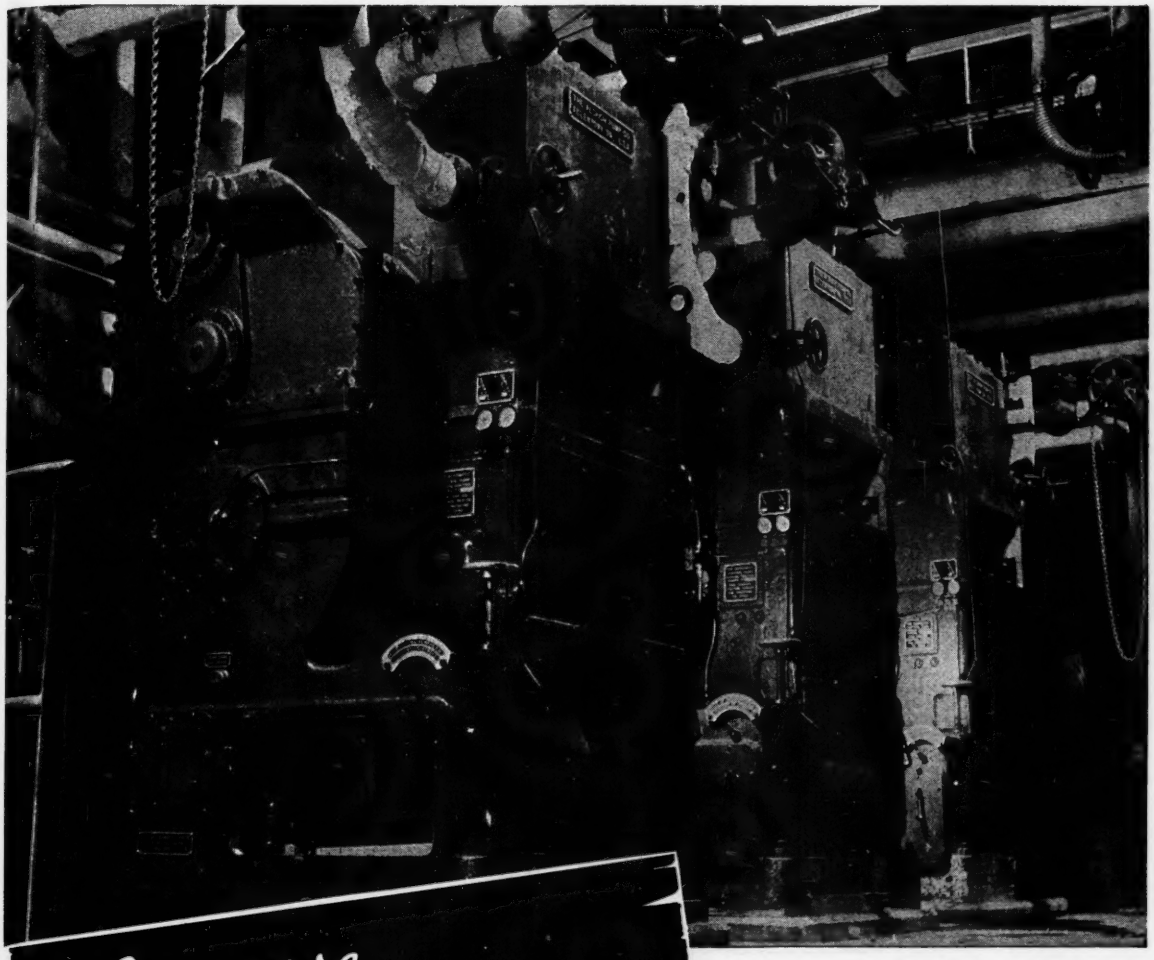
APPOINTMENT OF Frank M. Hawley as vice president and general manager, and his election to the board of directors, is announced by the directors of Morse Chain Co., Ithaca, N. Y.

Mr. Hawley, formerly manager of the Detroit plant, has been associated with Morse Chain since 1919. He continues as vice president of the company. He succeeds C. J. Kenerson, who retires as active head and continues as director and vice president. Stanley B. Waring, former secretary, was elected secretary and treasurer.

Announcement also was made that expansion costing upwards of one million dollars would be started at the Ithaca, N. Y., plant, anticipating substantially increased postwar demand for the company's products.

Standard Oil Elects Officers

STOCKHOLDERS OF STANDARD OIL CO. of Indiana at a recent meeting re-elected the board of directors and approved a resolution to amend the by-laws of the company by providing for indemnification of directors and officers against claims, liabilities, and expenses resulting from certain actions, suits, or proceedings. Following the stockholders' meeting the board of directors re-elected all former officers. They added two new officers by making Bruce K. Brown vice president in charge of development, and Buell F. Jones vice president and general counsel. Mr. Brown's title had been general manager of



Increase POWER PLANT EFFICIENCY with

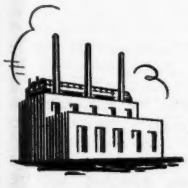
. . . ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMPS

Aldrich-Groff pumps on unit feed systems eliminate pressure and power losses common to throttling-type feed regulating valves and offer advantages of feed system simplicity, efficiency and mechanical reliability for small and medium installations at medium and high steam pressures.

Equally important overall power savings are effected by Aldrich-Groff pumps on de-superheater feed service in connection with high pressure topping units for power stations of any size.

The three Aldrich-Groff 3¼" x 0 to 6" variable stroke vertical triplex pumps shown above are in service in a mid-western central station employing the unit system for main boiler feed. Two are driven by constant speed motors and the third by a constant speed steam turbine. Power consumption is almost directly proportional to pump delivery.

The 6" stroke—3¼" plunger pump is a 100 HP unit and when operating at maximum speed can deliver 70,000 pounds of feed water per hour against 1025 pounds boiler pressure.



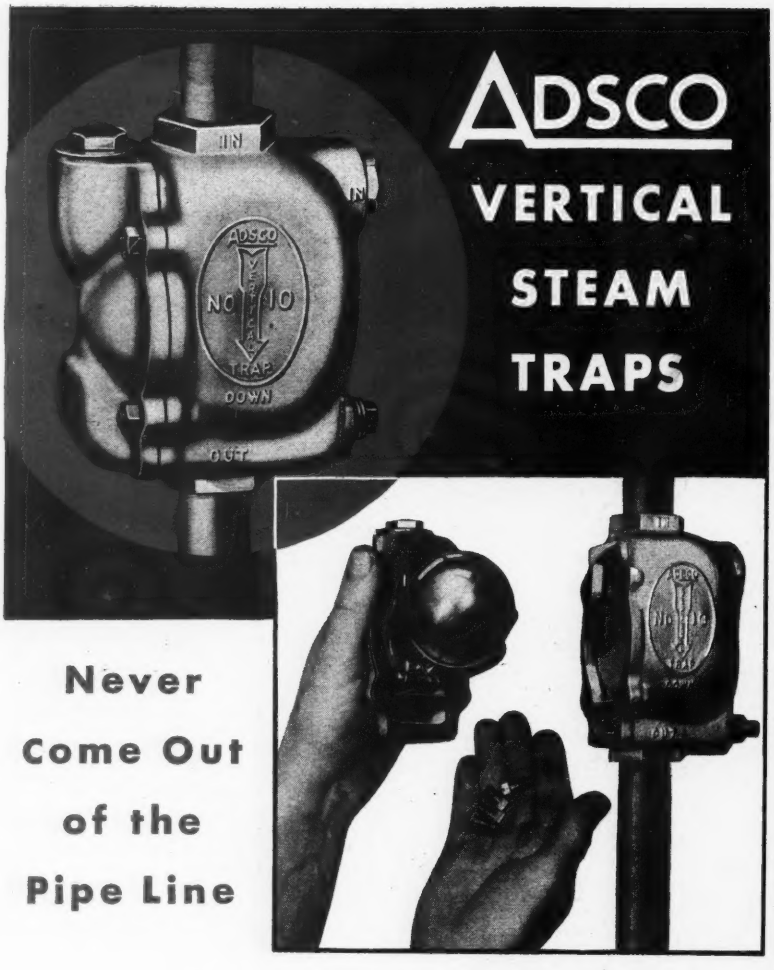
WRITE TODAY...

for bulletins and material giving full details, sizes and ratings of Aldrich-Groff Pumps.

THE ALDRICH PUMP CO.

7 GORDON STREET ALLENTOWN • PENNA.

REPRESENTATIVES: Birmingham • Bolivar, N. Y. • Boston • Chicago • Cincinnati • Cleveland • Denver • Detroit • Duluth • Houston • Los Angeles • Pittsburgh • Portland, Ore. • St. Louis • San Francisco • Seattle • Tulsa



Never Come Out of the Pipe Line

All working parts attached to cover

So light that it can be borne entirely by the piping — with valve and float mechanism mounted on cover, and all piping connections on the body, the Adsco Vertical Steam Trap need never come out of the pipe line.

If cleaning or adjustments are necessary the cover with all working parts can be removed quickly without disturbing the piping. By keeping an extra cover with valve assembly on hand this "spare" can be substituted in a few minutes with practically no interruption to service, and the original assembly taken to the work shop for servicing.

DOUBLE LIFE. This trap also has a reversible valve and reversible seat of non-corrosive stainless alloy steel which gives it double life. Write for Bulletin No. 35-86E and prices.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, NEW YORK
Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

research and development and Mr. Jones' general counsel. Joseph K. Roberts, heretofore director of research, was promoted to the position of general manager of research.

The re-elected directors are: Robert E. Wilson, A. W. Peake, Edward G. Seubert, Max G. Paulus, Harry F. Glair, Judson F. Stone, Roy F. McConnell, Bruce K. Brown, Buell F. Jones, H. E. Hanson, L. C. Welch, Frank O. Prior.

The re-elected and new officers are: Robert E. Wilson, chairman of the boards; A. W. Peake, president; Max G. Paulus, vice president in charge of manufacturing; Roy F. McConnell, vice president in charge of sales; Frank O. Prior, vice president in charge of production; Bruce K. Brown, vice president in charge of development; Buell F. Jones, vice president and general counsel; Ralph E. Clarke, treasurer and assistant secretary; Felix T. Graham, secretary and assistant treasurer; William C. Ewald, assistant secretary; Laban E. Harmon, assistant secretary and assistant treasurer; Carl T. Bergeson, comptroller; and Martin A. McNulty and O. M. Perrenot, assistant comptrollers.

Raybestos-Manhattan, Inc., Holds Open House

VISITORS TO THE number of some 4500 recently toured the plant of U. S. Asbestos Division of Raybestos-Manhattan, Inc., at Manheim, Pa., during four open house days. Manufacturing and processing operations involved in making brake-lining, clutch-facings, textiles, packings, etc., were on display during plant visitation days.

Employee-guides conducted groups of visitors through 14 buildings and 55 separate manufacturing departments on a 1½-hour tour. All areas of the plant not affected by war-time security regulations were open to the public. The open house staged for the first time since the outbreak of war, attracted visitors from all sections of the county in which the plant is located

Aeroil Changes Name

AEROIL PRODUCTS CO. has been adopted as the new name of the organization formerly known as Aeroil Burner Co. of West New York, N. J. Production will be continued on present lines of oil-fired industrial equipment but added emphasis will be given to new types of equipment for which research and development is now under way. The management points out that the new name avoids the apparent contradiction in the word "Burner" as applied to the many different types of electrical units now being produced by them.

Corning Glass Works has announced the purchase of a new plant at Leaside, Ontario, Canada, for the manufacture of a complete line of glass baking ware, the first to be made in the Dominion. Details were made public by Glen W. Cole, president, who explained that operations would be broadened as rapidly as possible to cover the manufacture of other types of glassware. The operations of the Canadian plant will be

1,250,000
Pounds of Steam Per Hour
FOR PHILLIPS PETROLEUM CO.'S BORGER, TEXAS
BUTADIENE PLANT

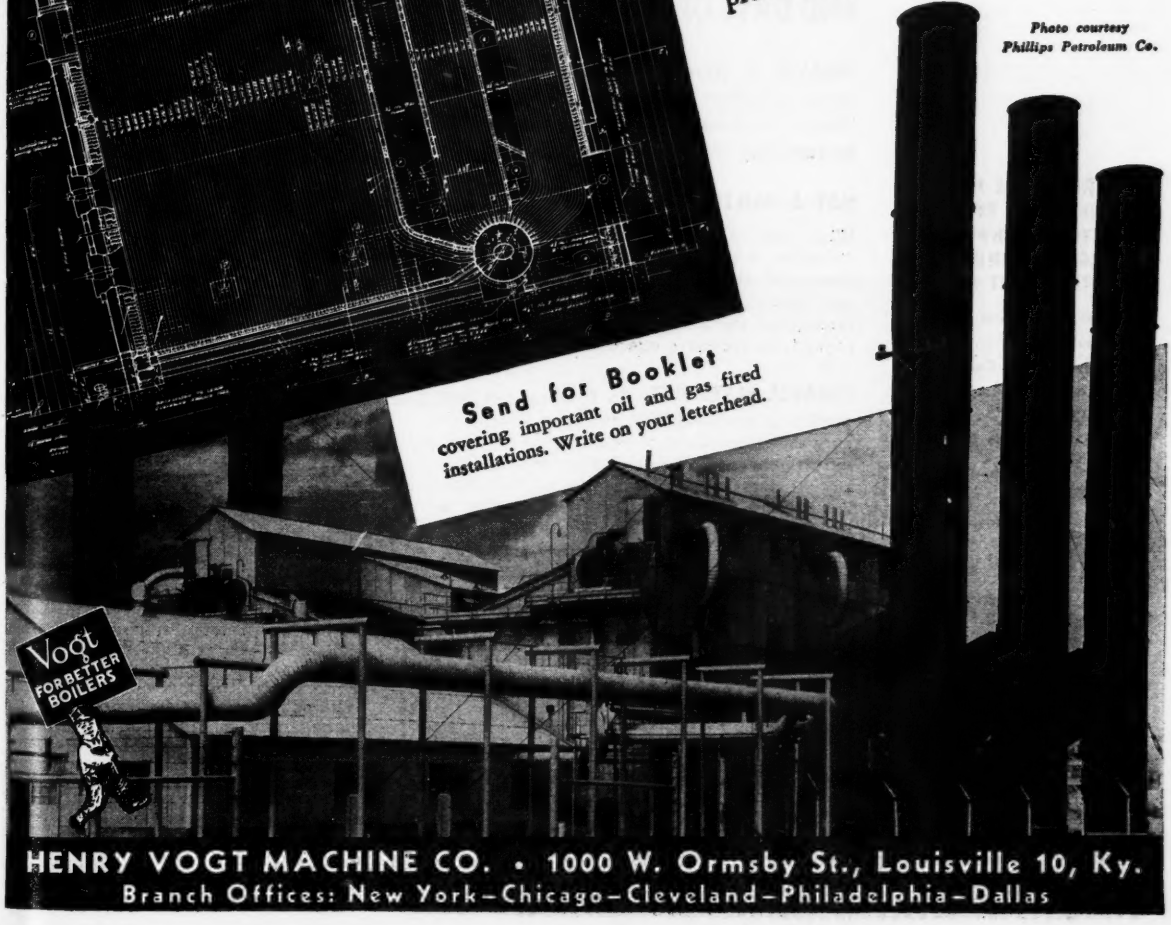
•

Five Vogt Class VR Steam Generators

provide 1,250,000 pounds of steam each hour for the production of butadiene, so vital to America's synthetic rubber program. The steam is used directly in process and for prime mover power with exhausts for process purposes.

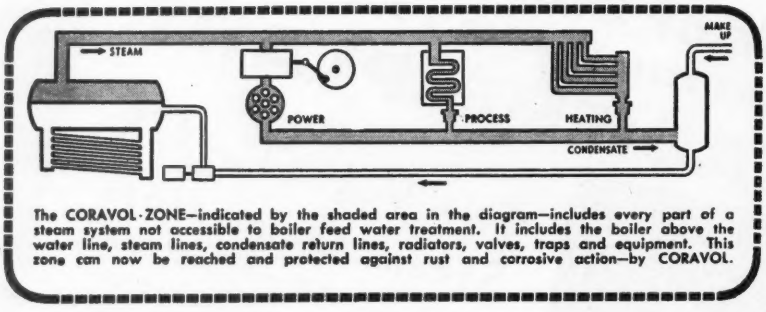
Photo courtesy Phillips Petroleum Co.

Send for Booklet
covering important oil and gas fired installations. Write on your letterhead.



HENRY VOGT MACHINE CO. • 1000 W. Ormsby St., Louisville 10, Ky.
Branch Offices: New York–Chicago–Cleveland–Philadelphia–Dallas

Here's How to PREVENT CORROSION *in Your Steam System . . .*



The CORAVOL-ZONE—indicated by the shaded area in the diagram—includes every part of a steam system not accessible to boiler feed water treatment. It includes the boiler above the water line, steam lines, condensate return lines, radiators, valves, traps and equipment. This zone can now be reached and protected against rust and corrosive action—by CORAVOL.

LINES CORAVOL BOILER

SAVES YOU COSTLY PIPE REPAIRS, REPLACEMENTS, MAINTENANCE LABOR, HOURS AND DAYS OF SHUTDOWN LOSS

CORAVOL in your steam system (1) prevents corrosion in steam and condensate lines, (2) cleans out clogging rust deposits resulting from previous corrosion.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE WHICH PROVIDES SPECIAL FORMULAS OF TREATMENT FOR:

Boiler Feed Water . . . Hot Water Supply . . . Refrigerating Brine . . . Cooling and Condenser Water . . . Rapid Scale Removal . . . Coagulation . . . Algae Control.

NOT A BOILER FEED WATER TREATMENT

When fed to your steam system, **CORAVOL** *volatilizes* with the steam, *condenses* with the steam, and dissolves in the condensate. It does not remain in any one zone, but circulates throughout the entire system and protects *all* zones from corrosive attack.

CORAVOL SAVES FUEL. In cleaning out and protecting lines **CORAVOL** increases and maintains the effectiveness of heat transfer surfaces; restores and maintains original capacity of lines and the operating efficiency of valves and traps. For 8 years, **CORAVOL** has proved its value in hundreds of steam heating, process and power plants in more than 20 different industries. Mail the coupon *today* for complete FREE data about the **CORAVOL** process.

MAIL TODAY

WESTERN CHEMICAL COMPANY
715 Washington Street — Kansas City 6, Missouri

Without obligation to me, please send complete data on the CORAVOL Process

NAME_____ TITLE_____

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ADDRESS_____

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handled through a wholly-owned subsidiary to be established for this purpose. The new plant being purchased from the Dominion Government is a portion of the plant formerly managed by Research Enterprises, Ltd.

R-S Products Corp. of Philadelphia, Pa. has appointed Fluid Controls Co. with headquarters at 18 W. Chelten Ave., Philadelphia, exclusive valve distributor for its products. The territory includes the Pennsylvania counties East of and including Potter, Clinton, Center, Huntington and Franklin; New Jersey counties south of and including Warren, Hunterdon, Mercer and Monmouth; the entire State of Delaware.

W. A. Taylor & Co., 7300 York Road, Baltimore 4, Md., manufacturers of pH, chlorine, phosphate and medical comparators, have increased its production and storage facilities by 50 per cent. Now a larger inventory of all sets can be carried and consequently practically all war orders, as well as those from industry and the medical profession, can be filled from stock. Many new comparators are planned to augment the already extensive line.

At a recent meeting of the board of directors of the Beaumont Birch Co., Philadelphia, the following officers were elected—President, Wm. G. Davenport; vice-president, Raymond A. White, Jr.; treasurer, G. T. Birch; secretary. M. H. Effrig; assistant secretary, Florence L. Birch.

Formal opening of the Keasbey & Mattison Co.'s enlarged research laboratory took place on May 25 in Ambler, Pa. The laboratory has been quadrupled in size during the past year and now contains the latest equipment for new product research, manufacturing proceses improvement and quality control.

MANUFACTURERS' *Personals*

Crane Co. has announced the following changes in its sales and branch house division, effective June 16: Carter T. Pollock, formerly manager of Crane's Branch, is appointed manager of the Central District with headquarters in Chicago; W. A. Burbine, formerly manager of the company's Cleveland branch is made manager of the Chicago Branch; A. N. Rosborough, formerly manager of the Toledo Branch is appointed manager of the Crane Branch in Cleveland; W. D. LaRue, manager of the Muncie, Indiana branch is promoted to the managership of the Toledo branch; and R. C. Danielson, formerly manager of the Plumbing Department at the Indianapolis Branch is made manager of the Muncie Branch, replacing Mr. LaRue.

The Foxboro Co., Foxboro, Mass., announces the addition of Harry D. Wagner to its staff of engineers serv-

FOR THESE QUESTIONS

1. How to really improve operations ?
2. How to definitely cut maintenance ?
3. How to effectively prevent spoilage ?
4. How to insure a higher product quality ?

THIS ANSWER

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE

THESE REASONS!

1. Maximum Capacity when needed most
2. Accurate Pressure Control under toughest working conditions
3. Trouble-free Service
4. Smooth Operation
5. Tight Closure
6. Accurate Regulation
7. Speedier Production Results
8. Elimination of Failures
9. Constant Delivery Pressure
10. Cost Saving Operation
11. No Spoilage
12. Practically zero in maintenance costs

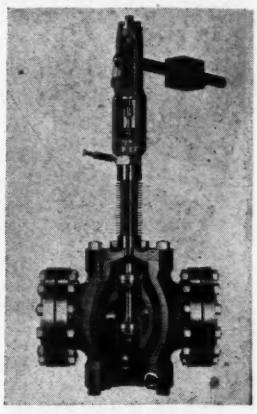
Type 1000-HP normal size diaphragm. Made for delivery pressures over 30 lbs.

Type 1000-LP has large diaphragm. Made for delivery pressures under 30 lbs.

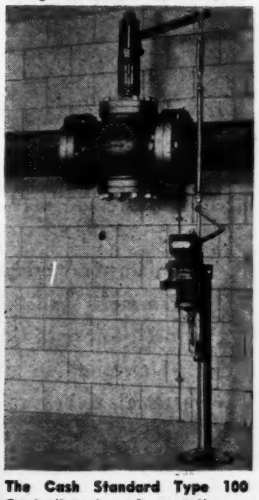
CASH STANDARD CONTROLS .. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

OTHER VALVES *from the* CASH STANDARD LINE



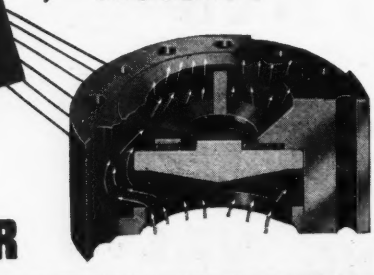
Cash Standard Balanced Valves, Series 42, have no lost motion. Have roller guides that kill side strains; stop packing trouble. Practically no maintenance. Sizes ½" to 12"; pressures up to 600 lbs. temperatures to 800° F. Bodies: iron, bronze, steel; all standard trims. With Air Cooled Packing Box (42-AC-R) shown above; or water cooled; or no cooling box. Made also with center guide. Bulletin 965.



The Cash Standard Type 100 Controller above is operating an 8" Type 42-R Balanced Valve, automatically reducing 250 lbs. down to 125 lbs. pressure, handling 200,000 lbs. steam per hour.

Type 100 Controllers have lots of operating power, enough for any size valve; are fully compensated; have adjustable range; are very sensitive. Bulletin 963 covering the Controller and Bulletin 965 covering the Valve give complete and interesting details. Write for them.

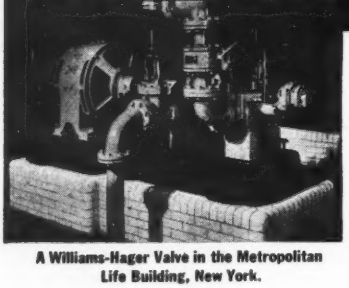
THIS NEW INFORMATIVE CATALOG WILL SOLVE YOUR "WATER HAMMER" *Problem!*



WILLIAMS-HAGER

FLANGED *Silent*

CHECK VALVES



A Williams-Hager Valve in the Metropolitan Life Building, New York.

- *Precision Engineered*
- *Economical*
- *Efficient*
- *Frictionless*
- *Tight Under Every Operating Condition or Pressure up to 6000 Lbs.*

Williams-Hager Flanged Silent Check Valves completely eliminate "Hammer" and "Bang" in the lines, provide uninterrupted constant flow of liquids.

Unlimited in size or application, from 1" to 20", built of materials to best suit the end use, Williams-Hager Flanged Silent Check Valves have been chosen for years as standard equipment in such exacting line uses as oil, gasoline, acids, water, chemicals, gas, air, salt water, brine, etc., regardless of temperature.

Write today for YOUR copy!

THE WILLIAMS GAUGE COMPANY

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

3000 PENNSYLVANIA AVENUE · PITTSBURGH 12, PA.

ing the Cleveland area. He has taken up his new duities, with headquarters at the company's office, 417 Bulkley Bldg., 1501 Euclid Ave., Cleveland 15, Ohio.

Carnegie-Illinois Steel Corp. has announced the appointment of John Mitchell as manager of the products section of the alloy sales division, effective June 1. Mr. Mitchell leaves the position of alloy metallurgical engineer of Carnegie-Illinois Steel Corp. to take over the management of the products section.

A. M. Andrews has joined the staff of the Briggs Clarifier Co. of Washington, D. C. As one of the Chief Service Engineers for the Aviation Division, he will concentrate his activities chiefly on commercial airline service. Entering the Ferry Command as a civilian pilot soon after Pearl Harbor, Mr. Andrews was shortly afterwards commissioned 2nd Lieutenant in the Army Air Forces. And before his discharge as a Captain in 1944, he had to his credit five Atlantic crossings as well as 84 missions "Over the Hump" while in the China-Burma-India Theatre.

G. P. Vincent, manager of the sales development and technical service department of The Mathieson Alkali Works, has been appointed to the newly created position of technical director. In addition to his former duties, he will direct research and technical development and advise on technical matters concerning plant operation. In these latter capacities, he succeeds R. E. Gage, who was director of research and development for Mathieson for 14 years and has now been appointed technical advisor of the Company.

C. A. B. Halvorson, consulting engineer for the General Electric Lighting Division at Lynn, Mass., and one of the nation's outstanding leaders in the outdoor illumination field, retired May 1 after 47 years with the Company. He is holder of more than 100 lighting patents, including the G-E sodium, mercury and Form 79 incandescent luminaires, and invented the control mechanism which allowed the famous luminous arc lamp, developed by the late Dr. Charles P. Steinmetz, to be placed on the market in 1903. He later developed the ornamental luminous arc lamp for "white way" business street lighting, introduced by him in 1910.

Westinghouse Electric Corp. has announced the following changes in personnel: Frank W. Godsey, Jr., as manager of the New Products Division, replaces G. H. Woodard, who has been transferred to South Philadelphia as manager of the Corporation's Aviation Gas Turbine Division. C. E. Stephens, vice president, has retired from active service with the company after forty-five years of service. Albert L. Wiegenstein has become apparatus and supplies manager for the North Pacific District of the Westinghouse Electric Supply Co. Charles R. Lee, formerly manager of the Westinghouse Electric Supply Co. in Miami, Florida, has

. . . *in thousandths of an inch*

Mechanical protection of boiler tubes and drums for long periods of time is provided by a brush-applied coating only a few thousandths of an inch thick. This coating is APEXIOR NUMBER 1, a chemically-inert, boiler water and steam resistant paint especially developed for metal surfaces.

Applied by hand brush or power coater, APEXIOR fills the metal pores and joints, preventing contact between metal and water or steam, thus greatly improving internal boiler conditions. APEXIOR also

1. Makes cleaning easier and required less often;
2. Prevents chemical bonding of dirt and scale;
3. Assures better heat-transfer over extended period by keeping boiler cleaner;
4. Prevents acceleration of stress corrosion or embrittlement due to water contact.

THE COATING IS EASILY MAINTAINED

Use of APEXIOR NUMBER 1 as a protection for boiler metal is recommended by all U. S. and Canadian boiler insurance companies. It is used by steam turbine manufacturers to coat shaft and rotor bodies. It is also used on feedwater heaters and deaerators.

FOR "COLD-WET" METAL SURFACES APEXIOR NUMBER THREE

APEXIOR NUMBER 3 provides similar protection for metal surfaces that are exposed to water or moisture at any temperature under 125°F. This special, shiny-black paint resists both fresh and salt water and can be used with potable water.

Organizations like these have used APEXIOR for years:

American Viscose Company
Bethlehem Steel Co.
Lehigh Portland Cement Co.
Firestone Tire & Rubber Co.
National Lead Co.
International Paper Co.
Gulf Oil Corporation
Carnation Co.
E. I. DuPont de Nemours & Co.
Omaha District Utilities

To learn what APEXIOR brush-applied protection can mean to you, write for Bulletin 1290, to the Dampney Company of America, Hyde Park, Boston 36, Massachusetts. *Main Office:* Hyde Park, Boston, Mass., *Branch Offices:* Atlanta, Chicago, New York, Detriot, Philadelphia. *Engineering Sales Representatives* — Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B.C., Montreal, P.Q., Havana, Cuba, Honolulu, T. H. *Marine Dept.*, 114 Liberty Street, New York 6, N.Y.

APEXIOR

Keeps new metal new . . . Gives old metal new life

The **DAMPNEY COMPANY** of America
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Mass.

Please send free Bulletin 1290 (Industrial) ☐ 1305 (Marine) ☐

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Company .....

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- Cadmium Plated Inside and Out
- High-Grade Woven Monel Wire Screen
- Readily Removed Steel Blow-Off Bushing
- Screen and Bushing Come Out Together—Go Back Together, Automatically Aligning
- For Steam Lines or Water, Oil and Other Fluids
- Reasonably Priced
- 6 Sizes from ½" to 2" for Pressures up to 600 lbs
- Many Thousands in Service
- Sold by Over 100 Mill Supply Houses

See Your Supply House or Send for Bulletin S-200

YARNALL-WARING COMPANY
114 Mermaid Avenue PHILADELPHIA 18, PA.

YARWAY STRAINERS

been appointed manager of the New Orleans Branch. L. J. Clay is now manager of the San Antonio, Texas branch of the Westinghouse Electric Supply Co. G. H. Lineberry has been appointed apparatus and supply manager for the Pittsburgh District.

Allis-Chalmers Mfg. Co. has announced the following appointments: J. C. Schaefer, field engineer of the Allis-Chalmers Pittsburgh district office, becomes branch office manager at Youngstown, Ohio. He will succeed E. H. Legler, who has been transferred to the electrical department at Milwaukee, Wis. L. E. Stacey, field engineer of the Pittsburgh district office, has been transferred to Wheeling, W. Va., as a resident field engineer. Grant M. Hinkamp has joined the Company as an industrial engineering specialist.

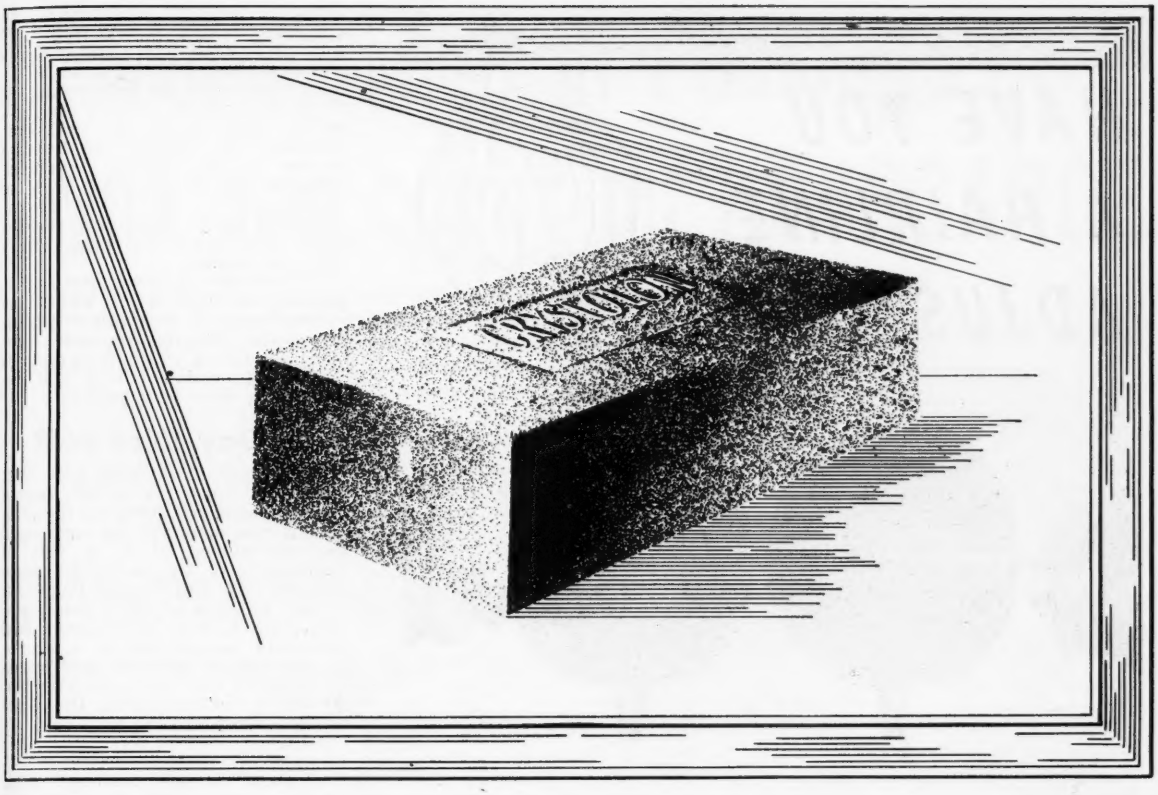
The Briggs Clarifier Co., of Washington, D. C., has announced the appointment of Charles W. Miller, Jr., who has been actively associated with the aviation industry for more than 20 years, as a member of the engineering staff. 'Another appointment is that of George S. Garrard as chief engineer. Mr. Garrard, comes to Briggs from the engineering department of Jacobs Aircraft Engine Co. having previously been design analyst for the Pratt and Whitney Aircraft Corp.

NEWS *from* THE FIELD

Spraragen to Direct Welding Research

THE WELDING RESEARCH COUNCIL of the Engineering Foundation has announced the appointment of W. Spraragen, present executive secretary of the Council, to the newly-created position of director. The Welding Research Council is a co-operative scientific research organization which is engaged actively in the study of matters related to the science and art of welding. Sponsored by the American Welding Society and the American Institute of Electrical Engineers it operates in close co-operation with all major engineering societies. It has an annual budget of more than a quarter of a million dollars and these funds for research are provided by large users of welding and welded products, and various governmental agencies.

Mr. Spraragen has long been identified with research and welding. He has served as executive secretary of the Welding Research Council since its organization in 1935 and his connection with the welding industry dates back to 1918 when he was appointed research assistant to the Welding Research Committee of the National Council of Defense and the Emergency Fleet Corp. From 1920 until 1934 Mr. Spraragen was secretary of the Division of Engineering, National Research Council, and secretary of the American Bureau of Welding from 1921 until 1936. He



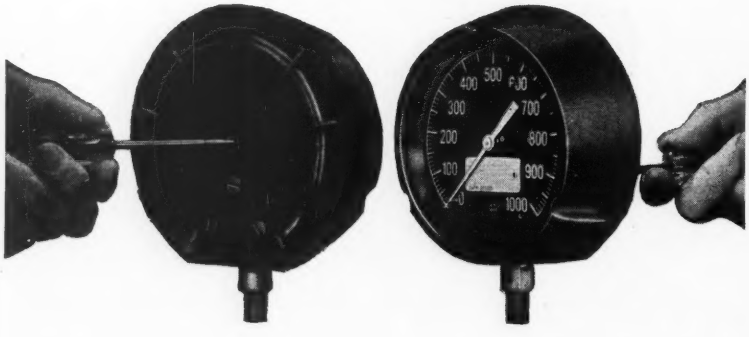
Portrait of a Successful Product: CRYSTOLON Brick

The success of CRYSTOLON Brick has been firmly established over a period of many years during which these highly refractory brick have given long, trouble-free service in stoker-fired boiler furnaces — as well as in water gas generators and in the combustion chambers of high temperature furnaces. Densely made of silicon carbide with a minimum of refractory bond, CRYSTOLON Brick have great resistance to abrasion, to spalling and to the chemical and physical action of molten slag. Clinkers may adhere to these brick to a very limited degree, but they are easily removed leaving the surface of the brick clean and unaffected for further service.

NORTON COMPANY - Worcester 6, Mass.

Norton Longer Lasting Refractories

HAVE YOU A HAIRLINE ADJUSTER ?



Another exclusive feature of the Certified Gauge is the Hairline Pointer Adjuster. You can now reset your pressure gauge pointer externally from the back of the case, without removing the glass or pointer. Very convenient when testing gauges on a test pump or dead weight tester.

A slight turn with a screw driver rotates the roller pinion of the Helicoid movement and adjusts the pointer to the desired dial reading. The Hairline Adjuster cannot be jarred out of position. Only Certified Gauges are made with the external Hairline Pointer Adjuster.

After serving in the Navy for several years, Certified Gauges are now available to industry for prompt delivery. Many of the largest companies in the country are already using them.

All Certified Gauges have the patented Helicoid Movement and are guaranteed accurate to within ½ of 1%. They stay accurate longer. Send for new catalog today.

ARMY NAVY

Certified GAUGE AND INSTRUMENT CORP.

34-18 Northern Boulevard — Certified GAUGE U.S.A. — Long Island City 1, New York

served as technical secretary of the American Welding Society from 1927 until 1942 and is editor and business manager of the Welding Journal, official publication of the Society, of which he has been editor since publication was started in 1922. Mr. Spraragen was editor of the first two editions of the Welding Handbook published by the American Welding Society and is the author or co-author of about 70 critical reviews of the literature on practically every phase of welding.

An important duty assigned to Mr. Spraragen in his new post will be the administration of the work of a pressure vessel research committee now being organized which contemplates the expenditure in this field of $225,000 over a three-year period.

T. A. Day Joins BCR

BITUMINOUS COAL RESEARCH, INC., agency in charge of investigational and developmental work for the bituminous coal industry, has announced the appointment of T. A. Day of Huntington, W. Va., as special representative. He will conduct public relations activities of BCR and maintain contact with members, coal producers, associations of coal mining companies, railroads and manufacturers of coal-burning equipment for homes and industries. He joined the BCR staff on June 1.

Mr. Day comes to Bituminous Coal Research, Inc., from Island Creek Coal Sales Co. which he served as special representative from 1941 until May 31 of this year. He joined the Island Creek organization after having been associated with Appalachian Coals, Inc., in Cincinnati, Ohio, and Knoxville, Tenn., from 1934 to 1941. At ACI, he was successively manager of publications, manager of the advertising department, assistant secretary, and manager of the Southeastern Office at Knoxville.

He will have headquarters in Pittsburgh, being associated with Dr. Harold J. Rose, vice-president and director of research; Elmer R. Kaiser, assistant to president and assistant director of research; and Ralph H. Hopp, technical information service, present members of the BCR staff.

Society of Industrial Designers

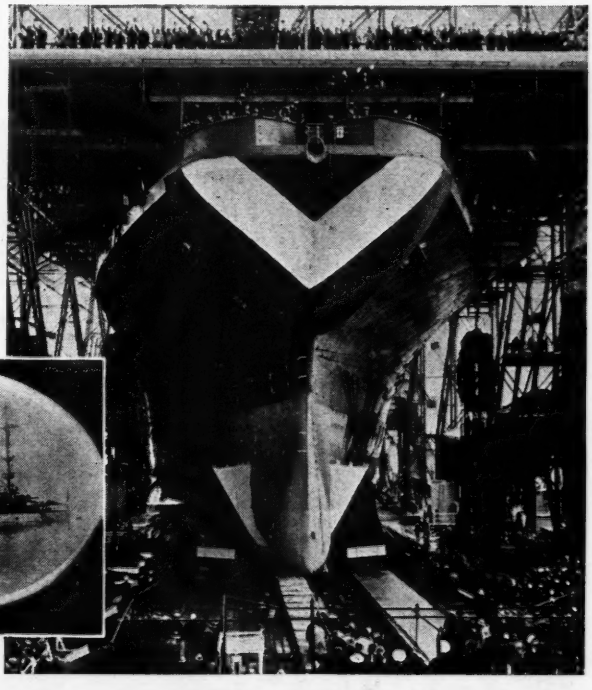
FIFTEEN OF THE NATION'S leading industrial designers have announced the formation of the Society of Industrial Designers. The officers of the Society are: Walter Dorwin Teague, president; Raymond Loewy, chairman of the executive committee; Henry Dreyfuss, vice president; Harold Van Doren, treasurer; and Egmont Arens, secretary. The other founders are Donald Deskey, Norman Bel Geddes, Lurelle V. A. Guild, Ray Patten, Joseph B. Platt, John Gordon Rideout, George Sakier, Jo Sinel, Brooks Stevens, and Russel Wright. The founders are serving as the board of directors of the Society, the first organization limited in membership to professional industrial designers.

Every industrial designer in good standing in the United States will be eligible for membership so that the organization will be truly representa-

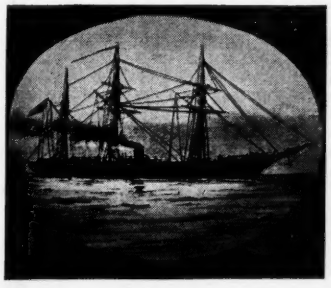
In Ships...and in Packings... you can count on KEARSARGE

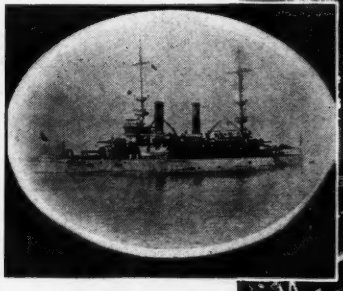
IN the course of naval history, three American warships have borne the name *Kearsarge*. The first had a long and honorable career as a 19th Century sloop-of-war. Then came the battleship Kearsarge, launched in 1900, and still in service as the world's largest seagoing crane ship.

And on May 5th of this year, a new Kearsarge—this one a huge 27,000 ton aircraft carrier of the Essex class—slid down the ways at Brooklyn Navy Yard to become the third fighting ship to carry on the tradition of this grand old name.



Right: Our Navy's newest "fighting lady"—the U.S.S. Kearsarge at her recent launching. Below, left: The first Kearsarge, famous old sloop of Civil War days. Below, right: The battleship Kearsarge—pride of the navy at the turn of the century.



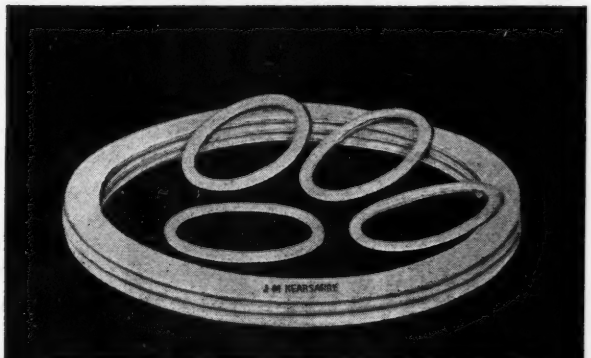


IN packings, too, the name Kearsarge has long stood for exceptional performance. J-M Kearsarge Boiler Gaskets—named in honor of the original U.S.S. Kearsarge—hold an enviable record among packing users for sealing boiler manholes, handholes and tube plates.

Product of J-M's 75 years of "know-how" in the manufacture of industrial packings, Kearsarge Gaskets are made of strong wire-inserted asbestos yarn treated with special heat-resisting compounds to provide long, dependable service in the boiler room. You can count on Kearsarge for maximum protection against costly gasket failures!

Kearsarge Rod Packing, for service against high pressure steam, and Kearsarge Sheet Packing, for rough flange service, are two of many other Johns-Manville Packings that are cutting repacking costs and helping reduce shutdown time on vitally needed equipment.

At your Supply House—or write Johns-Manville, 22 East 40th Street, New York 16, N. Y., for further information.



Kearsarge Boiler Gaskets are made in shapes and sizes for all normal handhole, manhole and tube plate requirements.

Johns-Manville

PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

tive of the profession. To distinguish the profession from other design fields the principal requirement for membership will be that each candidate for membership must have successfully designed a diversity of products for machine and mass production, or must be professionally engaged in teaching in this field.

The Society will assume the tasks and responsibilities of a professional association. A code of professional practice is in preparation. Information, advice, and assistance will be available to people and institutions engaged in teaching industrial design or engaged in public education in this field. The Society will provide machinery through which its members can co-operate on all matters affecting the profession.

The Society has a temporary office at 55 West 42nd St., New York 18, Philip McConnell, recently with the U. S. Treasury Department, has been appointed executive secretary.

Alien Patents

MANUFACTURERS, agriculturists, educational institutions and others in the Middle West will be offered complete working drawings on more than 45,000 patents seized from enemy countries.

The repository for this valuable collection of patent records is the library of the Midwest Research Institute of Kansas City, selected by the government after several months' negotiations with Howland H. Sargeant, chief the Division of Patent Administration, Alien Property Custodian's Office, Washington. The records are those seized from Germany, Italy, Japan and their satellites and from countries the Nazis overran.

The records consist of a complete index and guide to the vested patents and sets of abstracts of chemical, mechanical and electrical patents, covering virtually every field of industry. Most of the patents are of German origin and comparatively few from Japan.

Fees charged by the alien property custodian for use of an enemy patent, for its life, are $15.00 and patents owned by occupied countries are for the same amount, but the duration of such use is limited for the duration of the war and six months thereafter, when a small royalty of approximately one per cent is charged.

GE Plans New Research Laboratory

GENERAL ELECTRIC CO.'S new research laboratory, which is being planned will add some 50 per cent more space than present facilities provide, and will be erected near Schenectady at a cost of $8,000,000, according to announcement by president Charles E. Wilson. Construction will begin as soon as WPB approval can be obtained.

The site has been a private estate known as "The Knolls," and includes 219 acres. It is in suburban Niskayuna, about 4½ miles from the main plant and offices in Schenectary. Overlooking the Mohawk River, it is on a rocky cliff which will afford an excellent and solid foundation for the laboratory buildings.

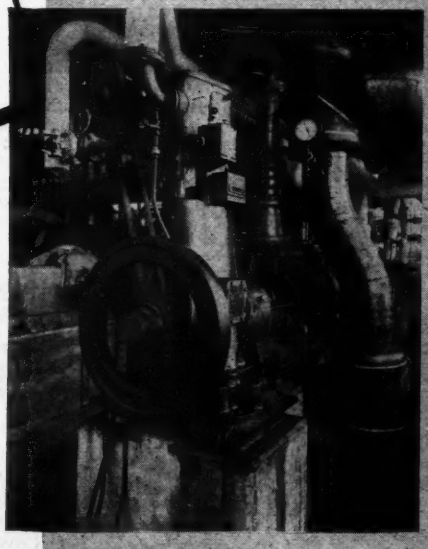
The new building, in the general shape of the letter T, will vary from two to five stories in height and will include 200,000 sq ft of laboratory working space in addition to an auditorium seating 300, a dining room, conference rooms, etc. One third of the laboratory space will be devoted to service facilities, machine shops and specialty shops such as glass blowers, all in a convenient central location.

Walls between rooms will be movable, capable of being placed at 18-in. intervals so that rooms may easily be made large or small as desired. Benches and all furnishings will be standardized so that they can easily be shifted from place to place as the need arises. The building will be air-conditioned throughout. Wires and pipes carrying various kinds and voltages of electricity, compressed air, suction, illuminating gas, hydrogen, oxygen, etc., will interlace the building whence they can be brought into any room.

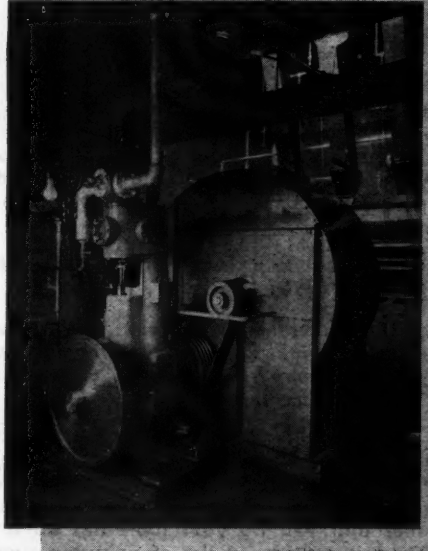
The high elevation of the site above the river will afford many advantages, for example, in experiments with radar, high frequency jet engines. The rocky cliff foundation will be useful in conducting experiments with x-rays. These are being produced at 100 million volts in the present laboratory, and further increases are expected.

Courtesy General Aniline & Film Corp.

TROY-ENGBERG POWER



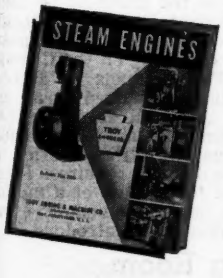
Low Cost because It's BY-PRODUCT POWER



SOME look for certain characteristics in a drive, such as flexibility, or wide speed range, or high starting torque, or sustained overload capacity. But *all* look for the lowest cost consistent with other requirements.

In the Troy-Engberg Steam Engine, you can find all. With the proper heat balance, it will produce power at a lower cost than any other drive.

How about a Troy-Engberg Steam Engine for your plant—to drive that stoker, or compressor, or pump, or fan?



Tell us about the equipment for which you need a drive, the available steam and where you can use the exhaust steam for processing or heating.

TROY ENGINE & MACHINE CO.

Established 1870

877 Railroad Avenue **Troy, Pennsylvania**

7-TEM-3

New Officer for REMA

THE REFRIGERATION EQUIPMENT MANUFACTURERS' ASSN. at a meeting of the new board of directors in the LaSalle Hotel, Chicago, May 24, elected as its president, F. J. Hood, vice-president of the Ansul Chemical Co., Marinette, Wis. He succeeds Arthur B. Schellenberg, president of the Alco Valve Co., St. Louis, Mo., as head of the association which comprises more than 75 members representing every branch of the refrigeration and air conditioning industries.

Other new officers chosen at the meeting were H. F. Spoehrer, Sporlan Valve Co., St. Louis, vice-president; Edward M. Flannery, Bush Manufacturing Co., Hartford, Conn., secretary; and J. A. Strachan, Weatherhead Co., Cleveland, treasurer. R. Kennedy Hanson continues as executive secretary with offices in the association's general headquarters in Pittsburgh.

New Officers for WSE

DR. HENRY T. HEALD, President of the Illinois Institute of Technology, has been elected President of the Western Society of Engineers for the year 1945-46 and was inducted at the 76th annual dinner meeting of the Society held June 4 at the Chicago Engineers Club. Titus G. Le Clair, Chief Staff Engineer, Commonwealth Edison Co., became first vice president, Robert B. Harper, vice president, Peoples Gas Light & Coke Co., became second vice president, and M. W. Casad, plant extension engineer, Illinois Bell Telephone Co., was elected treasurer.

New members of the Society's board of direction are Homer K. Smith, Northwestern Engineering Mgr., Westinghouse Electric Corp., and Ralph E. Turner, Editor, POWER PLANT ENGINEERING.

The special feature of this meeting was the presentation of Octave Chanute medals to Frank F. Fowle, Consulting Engineer, Frank F. Fowle Co. and Robert L. Anderson, Supt. of Public Works, Winnetka, Illinois, and the presentation of honorary membership certificates to Theodore L. Condron and Albert Reichman, also special certificates to the new life members were presented.

Boiler House for C. & O. Ry.

THE RUST ENGINEERING CO. will entirely replace a boiler house and boilers of the Chesapeake & Ohio Railway Co., without interrupting railway operation.

In the first stage of the work, four of six old, existing boilers will be removed, while the remaining two continue to furnish power. Half of the building will be torn down and replaced by a new structure. Two new boilers will be installed and steam generated to take over the power supply job.

In the second stage, the remaining two existing boilers and remaining section of the old building will be removed, and replaced by a new structure and two new boilers.

Contract for this work, to be carried out at the Huntington, W. Va., shops of Chesapeake & Ohio, is in excess of $600,000.

Products of Tomorrow Exposition

AMERICA'S FIRST ANNUAL Products of Tomorrow Exposition is being planned for an opening in Chicago on January 18, 1946, subject to military exigencies. The Chicago Coliseum, the North Hall Exhibition Bldg., the Armory, the Administration Bldg.—are all part of the group to be used. Gardner Displays Co. of Pittsburgh, has completed a design for the group of buildings centering on the Chicago Coliseum. The Products of Tomorrow Exposition is planned as an annual event and will comprise two main divisions, consumer and industrial products, with the addition of others as the demand requires. Plans are complete for the use of a million square feet to accommodate every one with a product to introduce.

Drafting Room Practices

ARMY, NAVY and industry representatives have met with the American Standards Association to form a committee that will tackle the problem of more completely coordinating drafting room practices. Initial production and design changes will be simplified by standardization of form and interpretation.

The Army and Navy have already set up committees within their jurisdiction to unify the practices in the various branches of the Services and

Solving 80% to 90% of all tube-cleaning problems is easy. It can be done without recourse to special designs or equipment—if you have the right formula. A review of literally thousands of tube-cleaning problems presented to Wilson Engineers shows that in eight or nine cases out of ten, the problem can be solved by this simple formula:

1. ***Choose the proper motor, cutter-head and accessory for the job.***
2. ***Plan ahead—it will assure you of having enough of the right kind of tube cleaning apparatus on hand when you need it. You may save valuable down-time this way.***

It's easy to apply this formula when you have a copy of the Wilson Tube Cleaners Check List. It will help you choose the correct Wilson motor, cutter-head, brush, flexible shaft or other accessory to assemble a tube cleaner that will do your job—and do it quickly. In addition it contains a list of valuable suggestions on planning ahead, and maintenance and operation of tube cleaners. Your copy will be sent on request.

wilson

MODERN TUBE-CLEANERS FOR THE PROBLEMS OF TODAY

TW-102

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

What this symbol means

to Users of Forged Steel Fittings

TO MARK PROGRESS

This symbol, the Ladish Drop Forge Co. trademark, means that each piece so stamped, was produced under exacting metallurgical, manufacturing and engineering controls—that the product so marked merits your complete confidence.

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN (MILWAUKEE SUBURB)

District Offices: NEW YORK • PITTSBURGH • CLEVELAND • ST. LOUIS • HOUSTON • LOS ANGELES

The Pace of Victory Permits Only A Congratulatory Handshake!

American Industry well merits a decoration for its brilliant record in the Mighty 7th! But, as our newly decorated Pacific heroes quickly return to combat, so industrial leaders aren't resting on their laurels. ***Back into Bond action***—they are now busy consolidating recent Payroll Savings Plan gains!

First, many executives are now patriotically working to retain the substantial number of new names recently enrolled during the 7th War Loan. By selective resolicitation, they are urging all new subscribers to maintain Bond buying allotments.

Second, many are also employing selective resolicitation to urge every worker who increased his or her subscription in the 7th to continue on this wise, saving-more-for-the-future basis.

Help to curb inflationary pressures and harvest peacetime prosperity by holding the number of Payroll Savings Plan subscribers—and amounts of individual subscriptions—to the mark set in the Mighty 7th!

The Treasury Department acknowledges with appreciation the publication of this message by

POWER PLANT ENGINEERING

★ *This is an official U. S. Treasury advertisement prepared under the auspices of Treasury Department and War Advertising Council* ★

Announcing

A new "RUN-AROUND" Boiler Room Conveyor

The LINK-BELT SIDEKAR-KARRIER

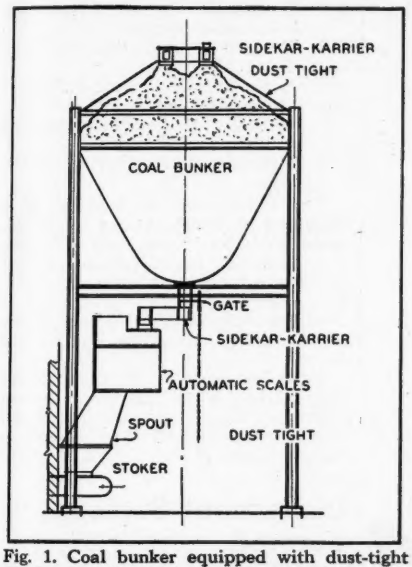
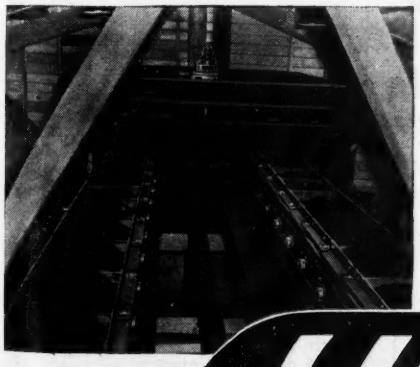


Fig. 1. Coal bunker equipped with dust-tight Sidekar-Karrier, with a similar unit feeding to automatic scales.



Above — Shows idler-sprocket end of SIDEKAR-KARRIER installation handling coal.

An Innovation in Modern Coal Handling

Indicative of the new (but tried and proved) products Link-Belt Engineers have created to meet the future requirements of industry, is this new type of conveyor. This unit has a number of features that reduce costs and improve coal handling in the power plant.

Requiring only from one to two ft. of vertical clearance, the SIDEKAR-KARRIER can be introduced in boiler plants previously equipped with overhead bunker and stoker spouts, if the installation of individual weigh scales for the boilers is desired. (See Fig. 1.)

Other advantages include: 1) Uniform feed within a horizontal path of travel, 2) Automatic discharge to several points, 3) Surplus material is recirculated in buckets until a new discharge point is found, 4) There is virtually no degradation in the conveyor, 5) There is no segregation in the conveyor, 6) Very little headroom is required, 7) Buckets and spouts are self-cleaning, 8) Less abrasion means longer life, 9) Low horsepower requirements, 10) Enclosed, no dust leakage. It is adapted to a wide range of capacities and conveyor lengths.

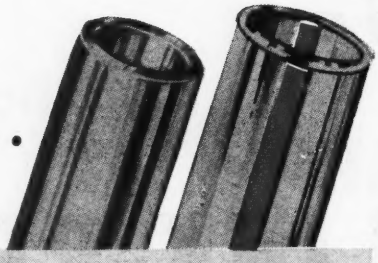
LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities. 9958

Send for copy of folder No. 2068 which gives complete engineering details and application data.

LINK-BELT
SIDEKAR-KARRIER

Safer TO USE . .
Easier TO SEE . .



SINCE 1907 SONDERGLASS has been setting the pace for safety. Its *double layer construction* gives notable resistance to inner heat and outer cold, and to breakage from hot tube contact with sudden cold drafts.

In repeated tests SONDERGLASSES have been dipped in hot oil at 450 deg. F. then plunged into cold water *without spalling or cracking.* Also resists clouding or discoloration no matter how long in service.

Comes in two popular types illustrated: CLEAR for use where water column is well lighted; REFLECTING with red and white enamel background to make water level plain as a bull's eye.

A. W. CHESTERTON CO. • 64 INDIA ST., BOSTON, MASS.
Distributors in Principal Cities

CLEAR

REFLECTING

ORDER FROM YOUR DEALER OR DIRECTLY FROM US

SONDERGLASS

"The Unbreakable GAUGE GLASS"

Cuts your gasket costs in half

The most remarkable tool ever invented.

Write for Booklet

THE ALLPAX GASKET CUTTER
Manufactured by
THE ALLPAX COMPANY, INC.
Distributors everywhere *Mamaroneck, N. Y.*

have authorized the American Standards Association to coordinate this activity with industry.

Due to the present lack of uniformity in drafting room practices, a contractor is frequently required to make sure that his own organization, as well as his subcontractors, make the necessary adjustments between the varied practices involved. Uniformity will permit a more effective use of technical personnel engaged in the work.

A joint Army-Navy committee has already outlined the initial scope of much of the job ahead which will deal with the following subjects in the fields of civil, mechanical, electrical, aeronautical, and marine engineering:

1. Abbreviations
2. Methods of Indication and Specifying Threads
3. Method of Lettering
4. Drawing Forms and Sizes
5. Graphical, Diagrammatic and Schematic Symbols
6. Methods of Indication and Specifying Materials
7. Methods of Indicating and Specifying Finishes
8. Methods of Dimensioning and Indicating Tolerances
9. Methods of Numbering Drawings.

The Committee is working on a standard of abbreviations which because of their universal use will make a pattern for the development of a procedure for other standards. Standards are also being developed on Methods of Specifying Threads, Types of Lettering, Drawing Forms and Sizes.

Framework for a sectionalized manual has been drawn up in considerable detail and circulated for study. As standards are agreed on they will be issued as parts of the manual.

Instrument Society Formed

THE INSTRUMENT SOCIETY OF AMERICA was organized in Pittsburgh on April 28 at a conference attended by delegates from 15 measurement and control instrument societies that have been growing in different industrial centers throughout the country.

The purpose of the Society will be to advance the arts and sciences that are connected with the theory, design, manufacture and use of instruments. The society is non-professional, and offers membership to any person, firm or institution interested in the objectives of the Society.

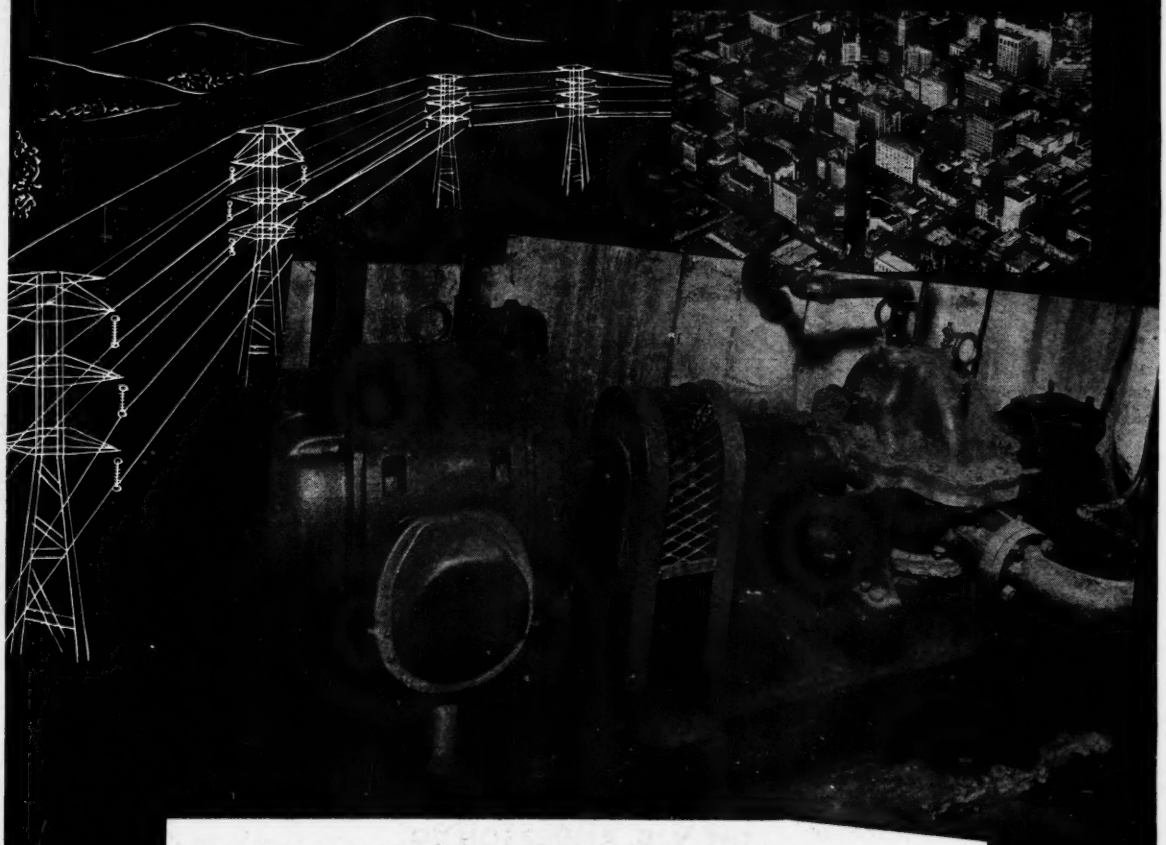
Pro-tem officers were elected as follows: President, A. F. Sperry, Chicago; vice president, C. F. Kayan, New York; treasurer, C. E. Fry, Pittsburgh; secretary, Richard Rimbach, Pittsburgh. Various committees were also appointed to proceed with the organization work, and preparation of constitution and by-laws. The office of the secretary is the temporary office of the Society and is located at 1117 Wofendale St., Pittsburgh 12, Pa.

Municipal Light and Power Plant of Norwalk, Ohio, plans installation of a 3,000-kw turbine generator, switchgear, auxiliaries and building addition. Cost $300,000. William C.

PERFORMANCE *Proves* DEPENDABILITY

and justifies selection of a special

WARREN PUMP



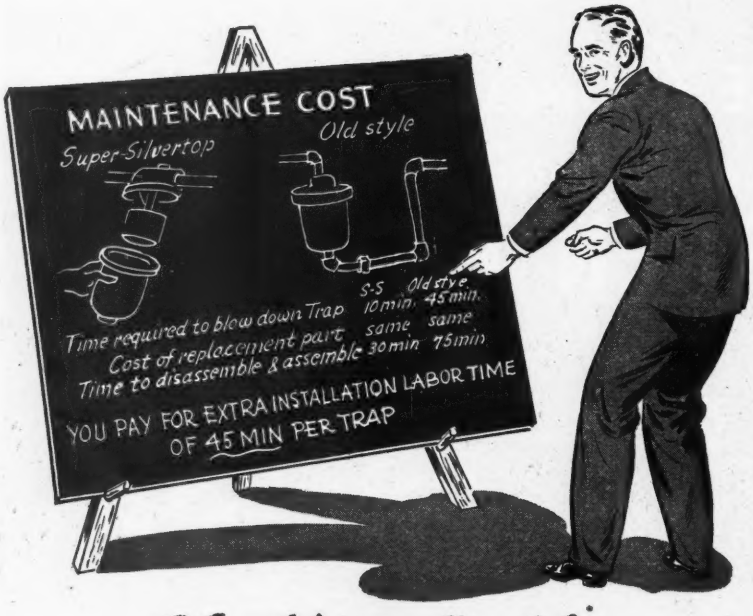
BY INDIANAPOLIS POWER & LIGHT COMPANY . . .

outstanding Middle-West public utility, whose record for service in a large, prosperous area is an enviable one. Their record for dependable, uninterrupted service is being matched by this Warren two-stage, single suction, bronze fitted Condensate Drain Pump which is an accessory to their 880# pressure steam turbine. Since installation, some four or five years ago, this pump has operated continuously with satisfaction. Such dependable, round-the-clock performance is nothing new for Warren Pumps . . . in fact it is "standard practice".

FOR LONGER LIFE AND GREATER DEPENDABILITY

WARREN STEAM PUMP CO., INC.

WARREN, MASSACHUSETTS



Chalk Talk No. 2

ON POSTWAR STEAM TRAP ECONOMY

It's good engineering practice to inspect steam traps regularly. The blackboard above shows how easy it is to inspect a Super-Silvertop Steam Trap without removing it from the line, and how difficult it is to inspect the traps with old style piping. Super-Silvertop trap inspecting can be made in 45 minutes less time . . . that's 45 minutes less labor to be paid for. Multiply this by the number of traps in use. For trap economy install only Super-Silvertops with simplified piping. Send for a copy of the book "How To Choose A Steam Trap."

Super-Silvertops can be piped as an elbow or straight-in-line.

THE V. D. ANDERSON CO.
1939 West 96th Street • Cleveland 2, Ohio

SUPER-SILVERTOP STEAM TRAPS

"Boiler Repairs Reduced 75%"
writes user of **NATIONAL GIRTH SEAM PROTECTOR**

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO

Kammerer and Associates, 1900 Euclid Ave., Cleveland 15, Ohio, Consulting Engineers.

Dover, Ohio—Municipal Light and Power Plant plans installation of a 4,000-kw turbine generator. Cost $215,000. William C. Kammerer and Associates, 1900 Euclid Ave., Cleveland 15, Ohio, Consulting Engineers.

The Sixth Annual Water Conference of the Engineers' Society of Western Pennsylvania will be held in the Hotel William Penn, Pittsburgh, Pa., on Monday and Tuesday, October 22 and 23, 1945.

Thomas J. Bannan, president of the Western Gear Works of Seattle and Los Angeles and its associate, the Pacific Gear & Tool Works of San Francisco, was recently elected vice president of the American Gear Manufacturers' Association at its annual meeting at Hot Springs, Va.

In addition to his 25 years of service with these two firms, Mr. Bannan is president of the Webster-Brinkley Co. and the Hallidie Machine Co., both of Seattle, and is a member of the OPA advisory committee for the gear industry. He has been active in the affairs of the AGMA for many years and prior to his election was a member of the association's executive committee.

John M. Rice, consulting engineer of Pittsburgh, Pa., has been appointed a member of the Board for Registration of Professional Engineers in Pennsylvania.

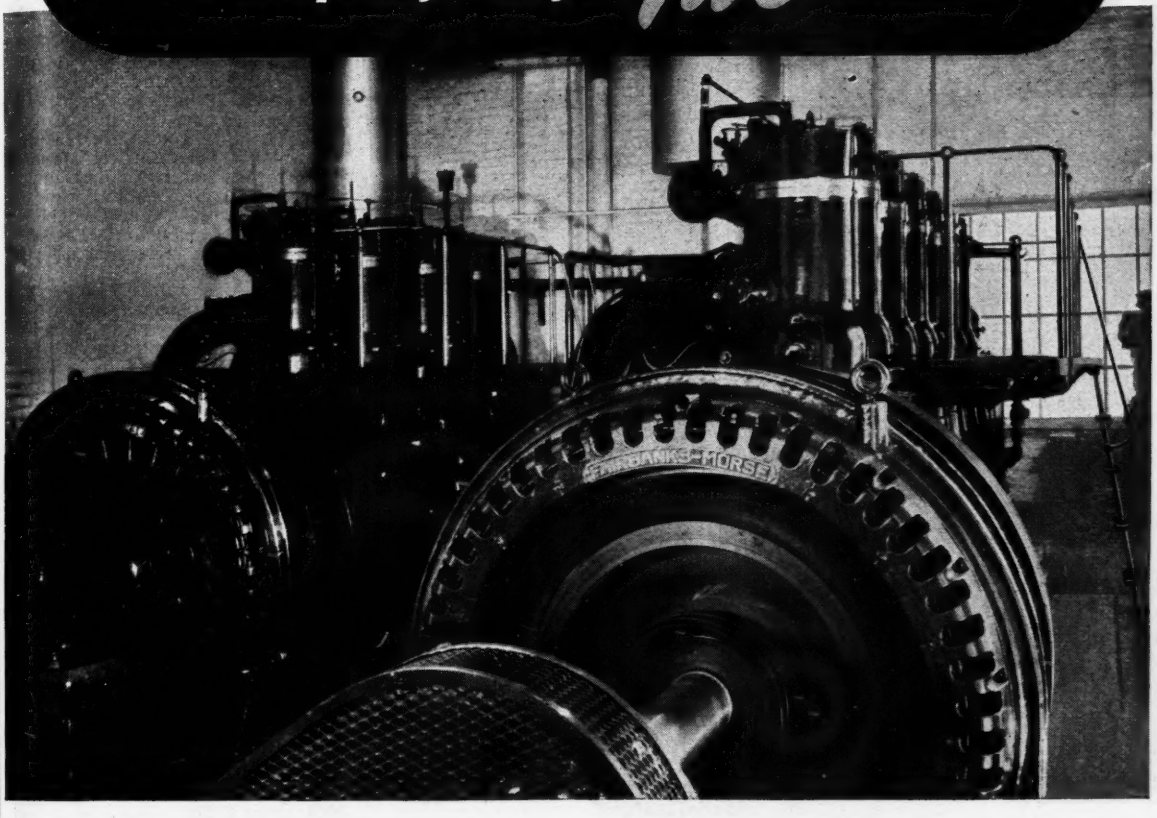
Announcement has been made of proposed construction by the Ford Motor Co. of an assembly plant and parts depot at Atlanta, Ga., to serve the Jacksonville, Fla., and Atlanta area. The plant would be located on an 82-acre plot purchased for the purpose by the Company. The location is on U. S. 41 near Hapeville. Present plans call for a one-story building with approximately 500,000 sq ft of floor space and designed for assembly of 350 automobiles daily.

On May 19 at Adelphia Hotel a group of Philadelphia power engineers paid proper tribute to Robert W. Given who had just completed 25 years as head instructor of the power plant class at the Philadelphia Adult Evening Schools. During this period Mr. Given instructed more than 2000 men and awarded a thousand certificates.

Professor G. L. Tuve of Case School of Applied Science, Cleveland, Ohio, has just been appointed head of the Department of Mechanical Engineering by President W. E. Wickenden to succeed Professor F. H. Vose, who has held the office for 31 years. Professor Tuve will start his new duties on July 1, after having served on the Case Faculty since 1930.

The Board of Directors of Public Service Corp. of New Jersey has elected Lyle McDonald and Jacob T. Barron Directors to fill vacancies occasioned by the death of the Corporation's former president, Edmund W. Wakelee, and the resignation of John L. O'Toole who is ill. Mr. McDonald, vice president and comptroller of Public Service, has been with the Company since 1916. He started as an accountant, was made comp-

Diesel Demonstrates $3,700 Saving – Company Buys *TWO* More!



JUST one year of Diesel operation saved the makers of Valdura heavy-duty maintenance paints $3,700 in plant power costs. So, as expansion plans went into effect, two more Fairbanks-Morse Diesels went into operation.

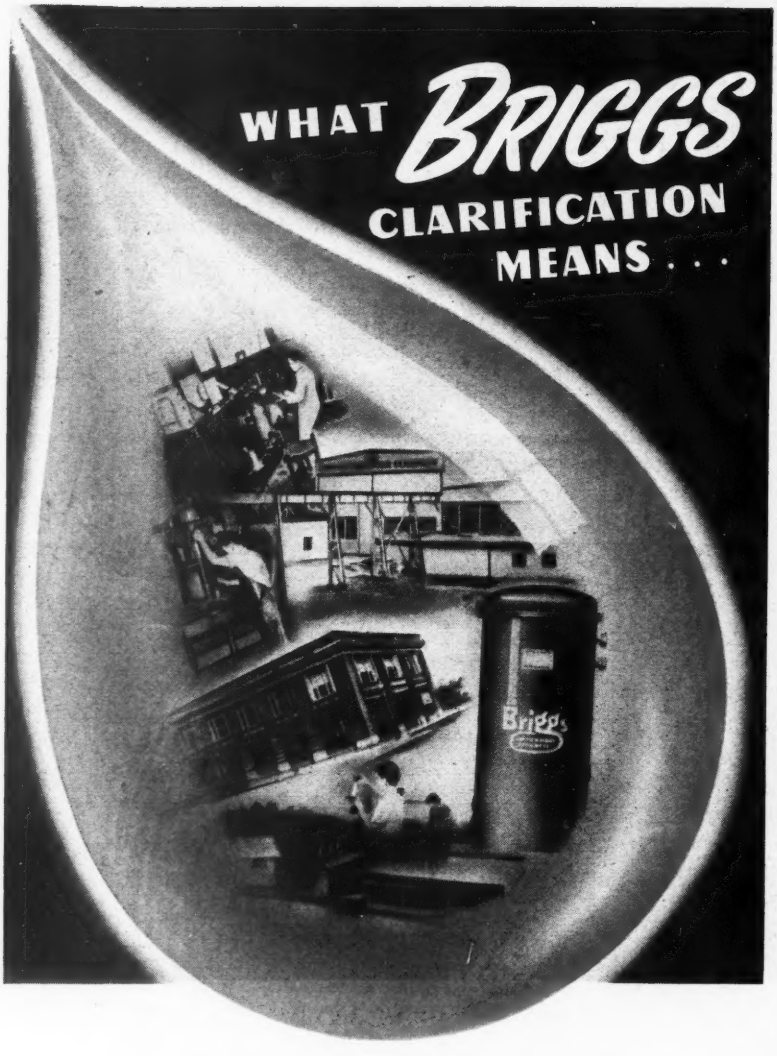
This is a typical experience. Such performance is built into Fairbanks-Morse Diesels. They're designed for heavy duty, economical operation, low maintenance costs, and long life. And Fairbanks-Morse Generators are built the same way. Fairbanks-Morse power generating units are engineered before you get them. One maker is responsible, one guarantee covers them. For information on how you can save on power, write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

BUY MORE WAR BONDS

Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps
Scales • Magnetos • Stokers • Railroad Motor Cars and Standpipes



BRIGGS CLARIFICATION is the result of continuous research in the field of fluids filtration . . . painstaking development of newest filtration media . . . accurate manufacture of parts and unit assemblies . . . competent, intelligent servicing of installed equipment.

These four factors make it possible for Briggs to supply the *correct* Briggs Clarifier for every size and type internal combustion engine . . . for every type of oil . . . for practically every purpose. Units for special applications continuously are being designed by Briggs engineers.

On land, on sea and in the air . . . in military use and industrial use . . . Briggs Clarifiers have proved their superiority.

Whatever your filtration problem . . . consult Briggs FIRST. You'll find experienced Briggs distributors in practically every principal city—listed in the "Filter" section of most classified telephone directories. Or—write to manufacturer for literature.

BRIGGS CLARIFIER CO. Briggs PIONEERS IN MODERN OIL FILTRATION **Washington 7, D. C.**

troller in 1937 and vice president last year. Mr. Barron, vice president in charge of electric operation, Public Service Electric and Gas Co., started with Public Service in 1907 and has been a vice president since 1935.

Dr. Charles E. Skinner, founder of the Westinghouse Research Laboratories, was honored recently by his former Westinghouse Electric Corp. associates at a dinner marking his eightieth birthday. Dr. Skinner had been retired by the Company in 1933 but accepted the Army's call to service in April, 1943, from which he recently retired as a civilian consultant of the Army Signal Corps. During the past two years he was stationed at Fort Monmouth, N. J., aiding in research and development work for the Signal Corps under Colonel Lee Sutherlin, who once worked as a research engineer under his direction at Westinghouse.

A recently published leaflet entitled,, "Jobs for the War Disabled," has been issued by the American Veterans' Association, 271 Madison Ave., New York 16, N. Y., and is available for anyone desiring copies. The leaflet is a plea to employers in behalf of disabled veterans pointing out the responsibility the country and its citizens should assume toward the defenders of the nation.

New ENGINEERING BOOKS

Electronics Today and Tomorrow by John Mills. First Edition, 5¾ by 8-in., 178 pages, cloth, published by D. van Nostrand & Co., Inc., 250 Fourth Avenue, New York, N. Y., 1944, price $2.25.

Here is a book on electronics that is really written for people who do not know anything about the subject. It is one of the very few books on electronics that has been written, that does not contain any illustrations at all. Reading this book will not make you an electronics specialist. It will not even make it possible for you to apply electronics in your work, but it will tell you many things about electronics that will make it easier for you to understand what all this business of electronics that you read about really means. The book is written by a man who is very skilled in the art of making technical information clear to the laymen. For many years John Mills was a member of the technical staff of Bell Telephone Laboratories and for almost three decades he has been a top line expositor of electrical science. During World War I he wrote the pioneering text on radio widely used in the signal corps. Later he wrote "Within the Atom," "Signals and Speech," "A Fugue in Cycles and Bels."

As in all of Mr. Mills' other books, the order of treatment in this book

UNION ELECTRIC uses LUMNITE FLUE LININGS in New Station

Union Electric Company's Venice No. 2 Station, near St. Louis
Stone & Webster Engrg. Corp., Boston, Engineers and Constructors
Gunite Concrete Construction Co., St. Louis, Cement-Gun Work
Wiederholt Construction Co., St. Louis, Chimneys

Lasting Protection for Uptake Flues and Fly-ash Precipitators

Burning 2880 tons daily of Illinois coal sets up serious abrasion and corrosion threats from ash and sulphur. In its new 160,000-kw station at Venice, Illinois, the Union Electric Company serving Greater St. Louis protected its uptake breechings and fly-ash precipitators against these hazards by installing LUMNITE linings.

The protective linings, of concrete made with LUMNITE cement and Haydite aggregate, were "shot" on by cement gun over reinforcing wire mesh previously attached to the steel. This method of application provided a solid, unbroken protective layer that covered seams, rivets, bends and corners, and hard-to-get-at places as well as the more accessible flat surfaces. Intimate contact between the LUMNITE concrete and the steel shell prevents moisture and gas from attacking the steel. The thin layer of LUMNITE concrete—two inches—also gives adequate insulation with minimum reduction of draft area.

In the chimneys, 125 feet high (above roof), LUMNITE mortar was used for laying the brick linings—assuring protection against attack by sulphurous fumes and moisture. Some intermittent operation of the plant is anticipated, with the resulting low-temperature periods that permit formation of corrosive condensate within the stacks. Union Electric had previously used LUMNITE mortar in chimney linings in their Cahokia and Ashley Street Stations and found it an effective method of controlling corrosion.

Many power plants use LUMNITE for a variety of purposes, such as:

* **Ash Pit and Cinder Catcher Linings**
* **Coal Bunker Linings**
* **Flue and Duct Linings**
* **Linings for Steel Stacks**
* **Mortar for Brick Chimneys and Linings**
* **Castable Refractories**
* **Overnight Structural Concrete**

Write for further information on the use of LUMNITE in power plants.

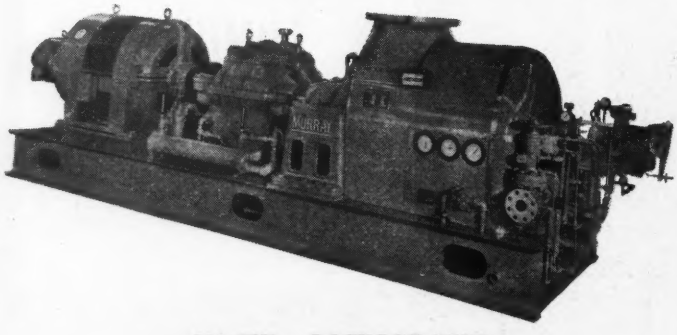
THE ATLAS LUMNITE CEMENT COMPANY

(United States Steel Corporation Subsidiary)

135 East 42nd Street • New York 17, N.Y.

MURRAY

TURBINE-GENERATORS



500 KW — PACKAGE TYPE

The unit shown was designed to deliver 500 KW alternating current on steam at 285 lb Gauge initial pressure, 700 degrees F. total temperature and 27 inches vacuum. Provided with a rigid structural steel baseplate, and with all service connections except generator leads above the floor line, the machine can be handled as a unit and installed with a minimum of preparation.

While "Package Type" units were furnished for export for installation in remote areas not previously supplied with power, the design can be utilized for small industrial plants for main or standby power supply.

MURRAY also produces

Mechanical Drive Turbines—Horizontal and Vertical
Reduction Gears
Steam Boilers

MURRAY IRON WORKS COMPANY

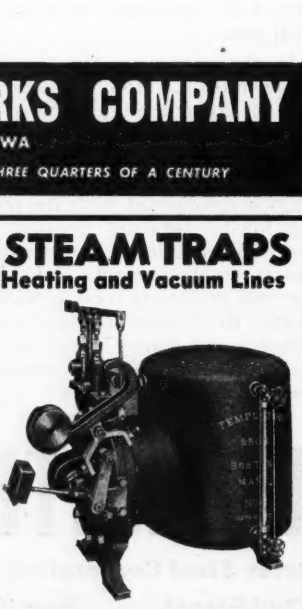
BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

TEMPLETON RETURN STEAM TRAPS

for Pumping, Boiler Feeding, Draining, Heating and Vacuum Lines

Pumps Water at any temperature or pressure.
Open float cannot burst or waterlog.
Valves and Seat Bronze or Stainless Steel.
Sizes 1 in. to 4 in. inlet and outlet.
Capacity 2500 lbs. to 60,000 lbs. water discharge per hr.



Ask for catalogue and prices

TEMPLETON BROS., INC.
699 Main St. Walpole, Mass.

is easiest things first. All of the material has been carefully chosen for its value as a quick introduction to the new things electronics is producing. All physics and electricity not immediately necessary have been ruthlessly omitted. The material presented, however, is scientifically accurate, with no omission of essentials or glossing of inadequate explanation, not at least, as the author puts it, by his intent.

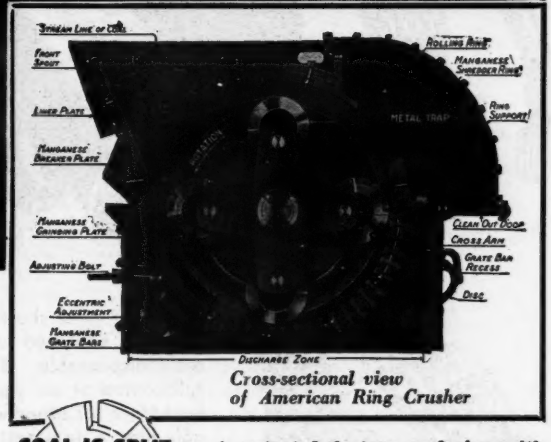
Mr. Mills starts out with the individual electron and its habits, such as clinging to a cat's fur, flashing across the heavens in a lightning stroke, moving under control in a vacuum tube. He explains how the electron produces x-rays, how it flows through metals, how they can be boiled out of a hot metal like steam out of a log. After introducing the electron, Mr. Mills shows how they act in electron tubes, shows how tubes are built, how they operate, how they produce the new current for curing plywood.

There is a chapter on television which tells you all you need to know about the technology of that new art unless you are a technician yourself. This book, however, is definitely not written for the specialist. Written in Mr. Mills' free and easy fashion you will find this book interesting as well as informative.

Electric Power Distribution for Industrial Plants, developed by the AIEE Committee on Industrial Power Applications, 100 pages, 7½ by 10-in., paper covered, published by the American Institute of Electrical Engineers, 33 West 39th Street, New York, N. Y., 1945, price $1.00.

This report is intended to promote the use of sound engineering principles in the design of electric power distribution systems for industrial plants and in the selection of equipment for the system.

For the purposes of the report the distribution system is considered as extending from the point of entrance of the power company service or the plant generating bus to the terminals of the utilization devices. This includes high tension substations, distribution substations, feeders, circuits, switch centers and protective equipment. The publication represents an immense amount of work coordinating available data on industrial distribution systems which has been pooled by a large number of the leading industries. We feel that this book will be of great interest and value to both the manufacturing and utility field. The book deals almost entirely with design; operating and maintenance problems are dealt with only insofar as they effect system and equipment selection. Within its scope the report analyzes the service requirements, voltage regulation problems, load characteristics and distribution system characteristics, and it also deals with the selection of equipment for distribution systems.



Cross-sectional view of American Ring Crusher

Handle the hard-to-prepare coals of today and tomorrow the easy "AMERICAN" WAY

With prolonged wartime restrictions on the flow of coal from one field to another, it appears that many boiler plants will continue to receive coal for which their equipment is not designed.

In making the best of these lower grade, hard-to-prepare fuels, why not do as scores of industrial plants and central stations are doing—insure better coal sizing the AMERICAN RING CRUSHER Way.

In one operation, the AMERICAN RING CRUSHER reduces run-of-mine or lump coal to sizes for stokers or unit pulverizers—at less than 1c per ton!

A patented feature exclusive with American Rolling Ring Crushers—Manganese Steel Shredder Rings with 20 cutting edges. Revolving free at terrific centrifugal force, they deflect unharmed in contact with tramp metal. No shear pins or conventional safety devices that require attention.

Then, too, the AMERICAN CRUSHER is designed for simplicity of operation and freedom from breakdowns.

It will pay you to find out how AMERICANS will give you exactly the fineness of coal for your plant conditions and for top combustion efficiency.

Write for FREE Data Book on Coal Sizing

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ROTO Tube Cleaners Provide One-man Operation

ROTO Model 135 air-driven motor with swing-frame head and air valve for one-man operation.

Wherever labor shortages exist, Roto Tube Cleaners, equipped for one-man operation, are indispensable. By giving the operator full control of air, you can not only release his helper for other work, but actually enable him to do a better, faster job. There is no time lost signalling a helper at a remote point to turn air on and off, saving many hours on the entire job. Whatever your tube cleaning requirements are, Roto can fill them satisfactorily.

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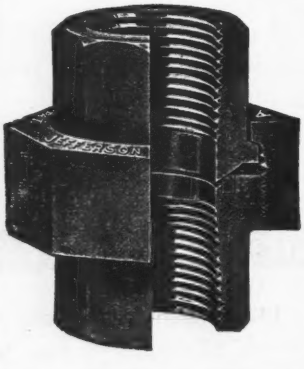

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JEFFERSON UNION

makes it unique

It is cut from seamless drawn tubing—free from all casting defects—sound and uniform always! It cannot be dislodged by a pipe end screwed in too far.

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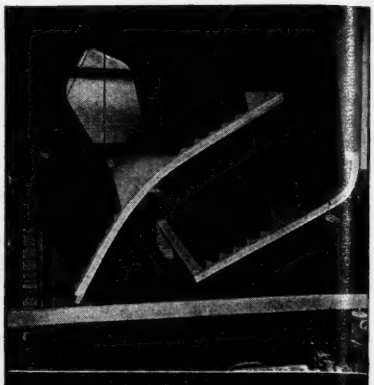
Factories at Lexington 73, Mass., and Lockport, N. Y.



Streamlining SAVES PRECIOUS FUEL

STREAMLINE the flow of gases across the boiler tubes and you get more steam from less fuel. That is what Enco Baffles do. They use scientifically curved baffle surfaces instead of sharp angles. They taper the passes to maintain velocity as the gases decrease in volume, which promotes heat-transfer. They:

- Eliminate bottle-necks
- Abolish dead gas pockets
- Reduce draft losses
- Speed heat transfer
- Keep heating surfaces cleaner
- Cut down use of soot blower
- Provide for tube expansion and replacement

Adaptable to any type of water-tube boiler, fired with any fuel. Designed for each individual installation. Only selected materials used. Installed by skilled mechanics. Send for Bulletin BW 44.

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Streamline Baffles
Produced exclusively by The Engineer Co.

ask yourself THESE QUESTIONS

Before Selecting a Piping Contractor

"Has he had extensive experience on jobs like mine?"

MIDWEST organization has erected piping for more than four decades and in that time has handled every type of piping job. Whether you have a power plant . . . a chemical or process plant . . . or whatever your piping needs may be Midwest offers you a wealth of experience on comparable jobs.

"Does his fabricating plant have all the facilities needed?"

MIDWEST has four modern pipe fabricating plants. Each is equipped for any kind of piping job: layout tables . . . bending equipment . . . work rotating fixtures for welding . . . special lap-forging machines . . . etc. You will find no better equipped pipe fabricating plants.

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"Are his organization and erecting facilities adequate?"

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MIDWEST has done more than that . . . among Midwest developments are the Globack joint which greatly improved lapped joints, the Midwest saddle for better reinforcing branch outlets, and a complete line of pipe welding fittings. Midwest piping research is continuous.

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PIPING FABRICATORS AND CONTRACTORS

WANT TO GET MORE WORK *from cookers and heaters?*

...handle condensate the Stout NO-VENT way

The Stout NO-VENT Pump has been engineered for one purpose: to operate continuously and return all condensate directly back to the boiler as fast as formed, and without the use of steam traps, vents or reheating.

With the simplified Stout NO-VENT System the condensate is returned at temperature and pressure at which condensed. This insures better circulation and drier steam in all heating units. That's why hundreds of plants operating cookers, heaters, driers, presses, etc., not only save up to 25% in fuel, but step up their production 10% or more.

Write today for bulletin showing hook-up of Stout NO-VENT Boiler Return System, giving operaitng details and practical guarantee chart of saving in boiler load. Made in capacities 100 to 800 bhp, pressures to 200 lb.

Distributors will be interested in details of attractive selling franchises now being offered.

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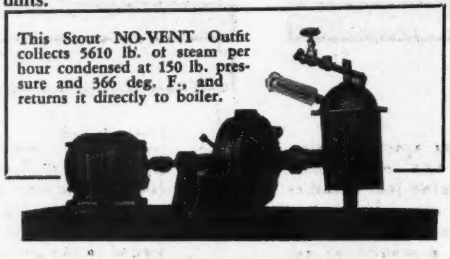
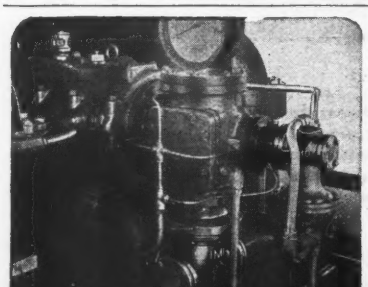


This Stout NO-VENT Outfit collects 5610 lb. of steam per hour condensed at 150 lb. pressure and 366 deg. F., and returns it directly to boiler.

Stout NO-VENT BOILER RETURN SYSTEM



IMO pump circulating governor oil and lubricating oil for large turbine.

CROWDED? *Install an* IMO

The IMO PUMP requires less space than most other pumps because of the high capacity attainable by its efficient, compact design and high speed operation. If desired, it can be directly connected to, and mounted upon, turbines, motors, engines, or other equipment. In special designs, dimensions and proportions can be varied to meet space limitations. I-128

For information send for Catalog I-128-C

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PUMP DIVISION OF THE
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Eastern gas and electric utility desires two graduate engineers, with about five years experience, for mechanical plant betterment work in field and office. Duties consist of steam plant testing and results analysis. Statement of availability required. Address Box 1482, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

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Give full experience, education, age, present salary and salary expected. Enclose snapshot.

Post-war opportunity.

Applicants must be able to obtain Statement of Availability.

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Manufacturer offers excellent opportunity to right man with good contacts. Full charge of sales. Write fully; all replies held in confidence.

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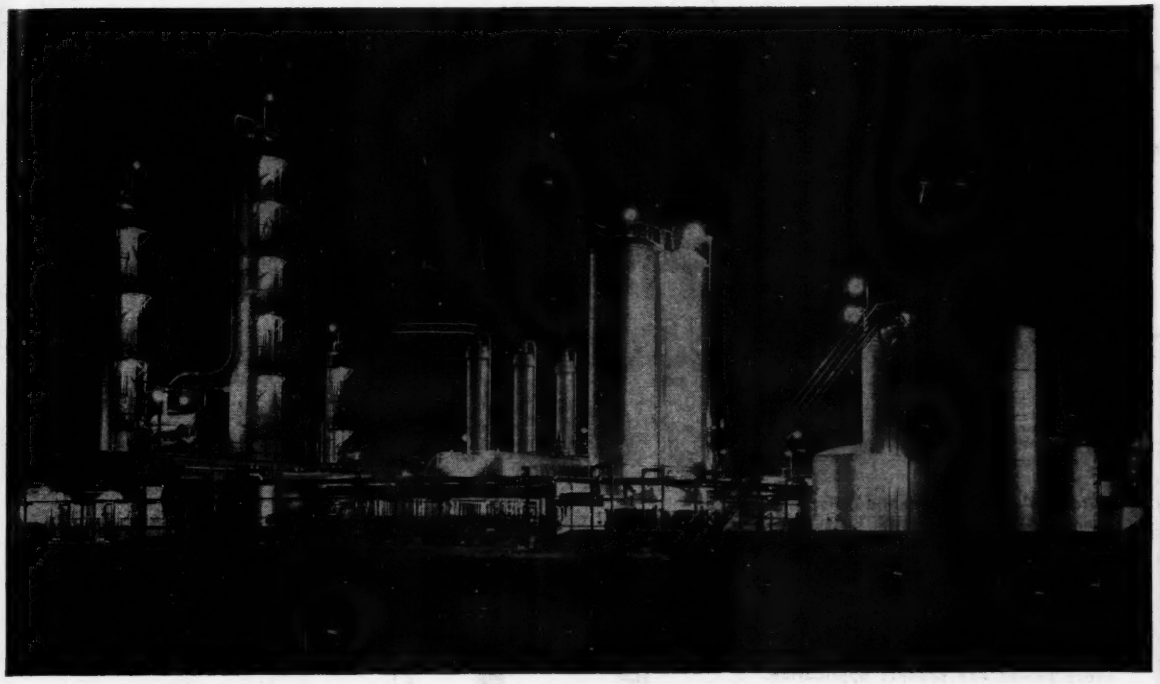

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Bowser XACTO Meters Speed Barrel-filling At Shell's Wood River Refinery

Important factor in the vital task of supplying our machines of war with gasoline and oil is Shell's Wood River Refinery . . . scene of production triumphs and the source of advanced refinery techniques.

Making lubricants and high octane fuel is an exacting job . . . demanding absolute control and clocklike precision.

And that's a perfect setting for the batteries of Bowser Meters that fill the barrels and drums of Shell's compounding and shipping department.

For, here, the range of requirements call for all the features for which Bowser Barreling Meters are famous. These include: extreme accuracy, unique temperature compensation for correcting measurement, a simple and effective predetermining mechanism—plus the speed and efficiency that is helping to keep Shell's "drums of war" rolling.

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In the power field, Bowser Turbine Oil Conditioners, Force Feed Lubricators and other liquid control units are daily saving labor and money. And, remember this. Wherever your plant may be located, there's a complete Bowser service organization close by. Ask a Bowser engineer to consult with you. No cost or obligation. Write today. BOWSER, INC., Dept. 4-G, Fort Wayne 2, Indiana.

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SINCE 1885

Not only has Bowser's war production earned the Army-Navy E... Bowser equipment has helped earn it for scores of other companies.

THE NAME THAT MEANS EXACT CONTROL OF LIQUIDS

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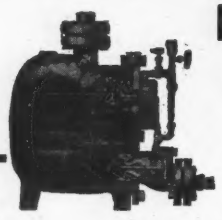

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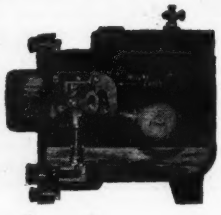

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W. H. NICHOLSON & CO. 160 OREGON ST. WILKES-BARRE, PA.

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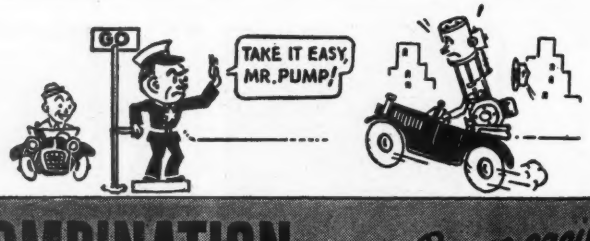

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NON-TILT, NON-SLIP VALVES

Protect Pumps against wasteful "over-speeding"

The tilting action of some reciprocating pump valves causes the seat to wear unevenly—which means the pump has to work faster and faster to carry its load.

COMBINATION Pump Valves enable you to get theoretical capacity out of your pumps without racing and wasting valuable steam. They prevent tilting and consequent pump slippage because they lift straight. They save on repair bills, too, because their seat, stud and springs are made of long-wearing Phosphor Bronze.

These improved pump valves match the fine performance of COMBINATION Silent Check Valves. Ask for descriptive folder with dimensions, prices and further information.

For Boiler Feed Vacuum, Condenser General Service

COMBINATION PUMP VALVE CO.

846 Wiota Street, Philadelphia, Pa.

Troubled with FIRE-SCALE and SOOT?

Use XZIT

FIRE-SCALE AND SOOT ERADICATOR

Today, few power plants can afford to waste time and labor to remove fire-scale and soot by old manual methods. Xzit reduces these fuel-wasting deposits chemically, so they may be dissipated automatically by natural draft or blowing.

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XZIT

FIRE-SCALE AND SOOT ERADICATOR

Plants at

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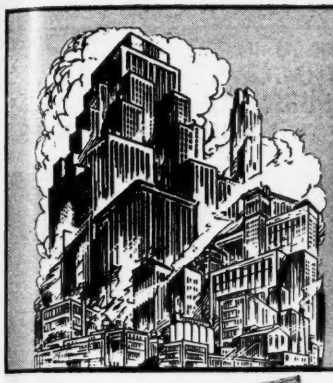

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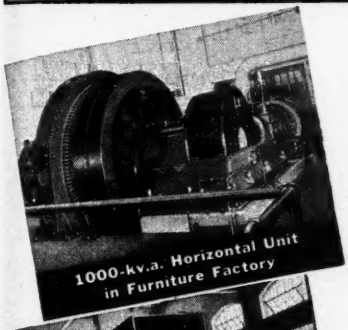
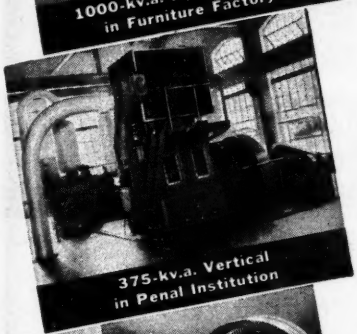
SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

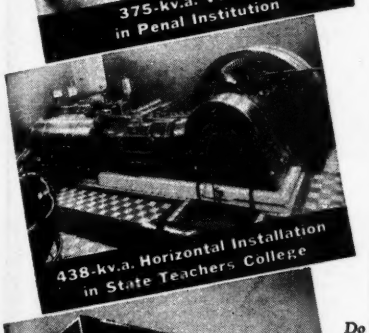
HAVE BEEN MEETING INDUSTRY'S DEMAND FOR DEPENDABLE, ECONOMICAL ELECTRIC POWER



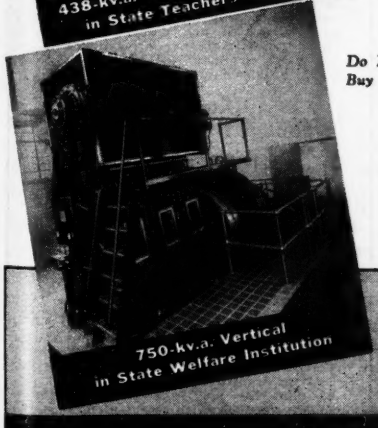
1000-kv.a. Horizontal Unit in Furniture Factory



375-kv.a. Vertical in Penal Institution



438-kv.a. Horizontal Installation in State Teachers College



750-kv.a. Vertical in State Welfare Institution

EXPERIENCE

For over three-quarters of a century, doing one thing well—building steam engines. This plant is the largest in the United States devoted exclusively to the building of steam engines, and the Skinner organization has justly acquired the reputation of being steam engine specialists.

THE "UNIVERSAL UNAFLOW"

The "Universal Unaflow" was the first American poppet-valve unaflow engine, and has earned popular recognition as "the most economical steam engine built." More "Universal Unaflow" engines have been built than all other American unaflow engines combined.

Two thousand power users, in industries and institutions of various types, have found it more economical to generate their own electric power with Skinner "Universal Unaflow" Steam Engines than to purchase power from the local utility, or to generate their power with other prime movers.

ADAPTABILITY

Suitable for noncondensing or condensing operation, with automatic change for either condition. Also may be built for constant or variable back pressures up to 30 lb.; medium or moderately high initial pressures, saturated or superheated steam.

MAINTAINED ECONOMY

Maintained economy is guaranteed, and is due to patented design of the poppet inlet and auxiliary exhaust valves, which are steam-tight after long use and under any variation of steam pressure or temperature. Steam consumption guaranteed subject to test after six months' operation, with final payment withheld until after test.

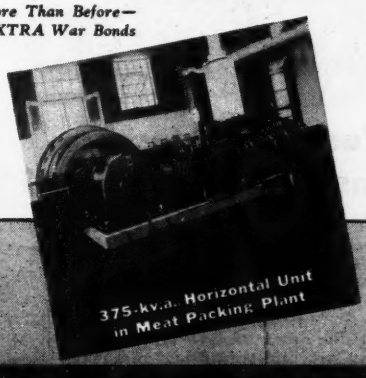
HORIZONTAL ENGINES

In general use for direct connection to electric generators, refrigeration equipment, compressors, blowers, pumps, etc. Special manual or automatic controls for variable speed and load requirements.

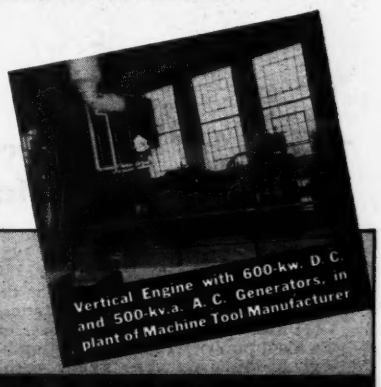
VERTICAL ENGINES

For limited space, or where other conditions make a vertical engine preferable, the stationary "Universal Unaflow" is offered in multi-cylinder vertical type, embodying the same fundamental economy and design features as the horizontal. Multi-cylinder vertical "Universal Unaflow" assemblies also extensively used for variable-speed compressor drive.

Do More Than Before—
Buy EXTRA War Bonds



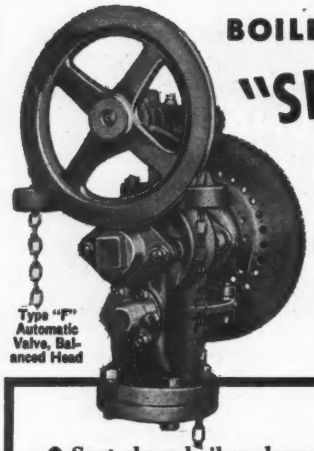
375-kv.a. Horizontal Unit in Meat Packing Plant



Vertical Engine with 600-kw. D. C. and 500-kv.a. A. C. Generators, in plant of Machine Tool Manufacturer

For Over 75 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.



Type "F" Automatic Valve, Balanced Head

BOILERS "SNAP OUT OF IT!"

MARION SOOT BLOWERS modernize boilers right now! They do this work:

- Increase boiler capacity and flexibility
- Save 5 to 10 percent on fuel bills
- Do the job mechanically and quickly
- Blow out soot deposits without injury to baffles.

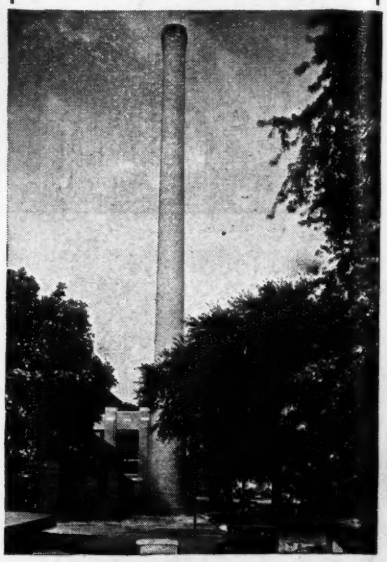
● Soot slows boilers down. *MARION SOOT BLOWERS* eliminate stubborn soot with minimum waste of steam. Type "F" for water tube boilers blows in any length of arc from 15 to 345 degrees. No lugs, stops, pawls, nor pins. "Keeps on Rollin'" to right or left as desired. Favorites with skilled engineers and power plant owners, *MARION SOOT BLOWERS* are made for all sizes and types of boilers. Parts are interchangeable. Continuous service with low replacement and repair costs.

Write for Specifications and Prices
Save Coal, Time, and Worry

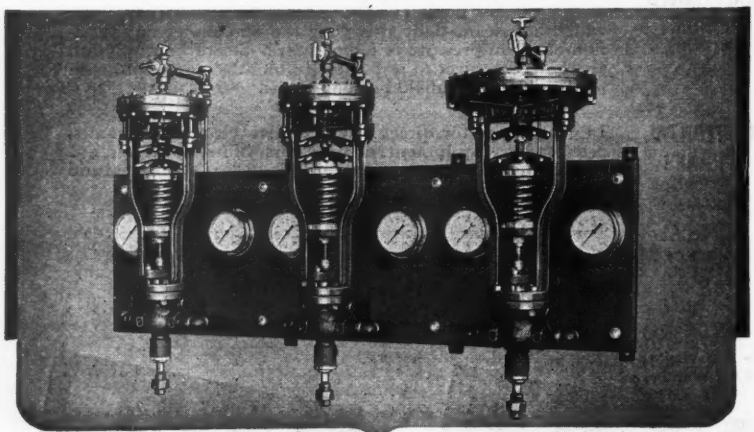
THE MARION LINE

MARION MACHINE, FOUNDRY AND SUPPLY CO. • MARION, INDIANA, U. S. A.

Consult Us For:
CHIMNEYS . . .
FURNACE WORK . . .
BOILER SETTINGS



AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES: BOSTON • PHILADELPHIA
CLEVELAND • DETROIT



There's a Solution **to Your Toughest Pressure Control Problems with SWARTWOUT REGULATORS**

YOUR IDEAS about *what* you want to accomplish in power control probably are perfectly clear. It's the *how* that is often the problem. That's where Swartwout can help you with suggestions gained in wide experience • As an example, the three Swartwout Type "CPM" Master Regulators above operate a 4" control valve in a three-way hook-up that (1) maintains a definite low pressure; (2) "unloads" if pressure exceeds a fixed point; (3) prevents pulling high side down too low • Swartwout gladly discusses your needs with you or your consulting engineers.

THE SWARTWOUT COMPANY • 18511 Euclid Ave. Cleveland, O.

Swartwout

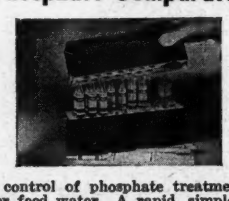
LaMOTTE BOILER FEED WATER TEST UNITS

The LaMotte Research Department has developed a reliable series of chemical tests for boiler feed water control of the following constituents:

Phosphates	Dissolved Oxygen
Chlorides	Sulfates
Total Alkalinity	Hardness
pH (Hydrogen-ion Concentration)	

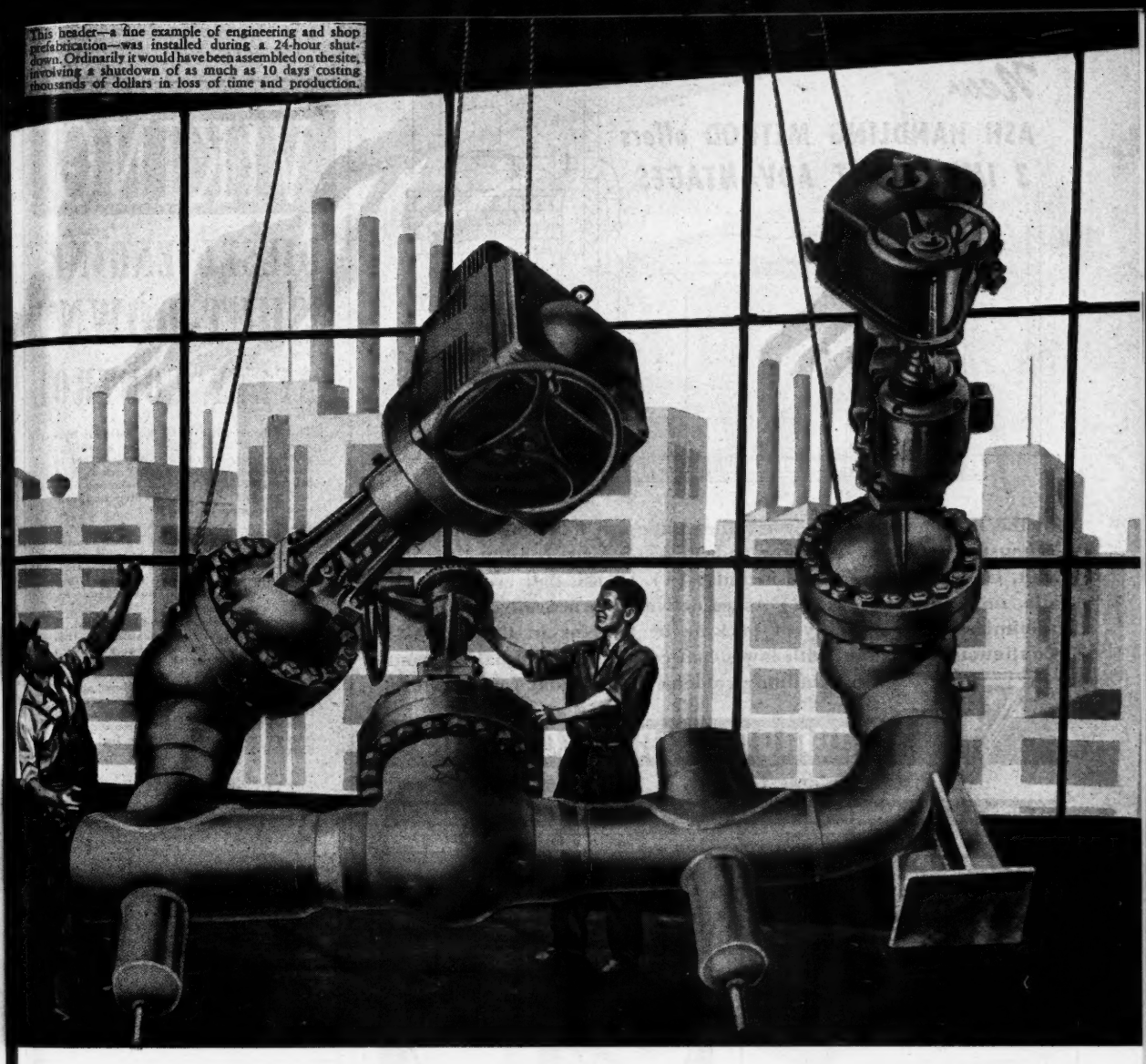
For positive control of efficient water treatment, there is a LaMotte Unit for each constituent (Phosphate Comparator, illustrated and described below). Each unit is simple to operate and inexpensive to install. Write for illustrated booklet describing this equipment.

LaMotte Phosphate Comparator



For control of phosphate treatment of boiler feed water. A rapid, simple and accurate method. The new LaMotte Comparator covers phosphate concentrations from 0 to 100 p.p.m. Can also be used for poly phosphates. Outfit comes complete with instructions.
Price $15.00 f.o.b. Towson.

LaMOTTE CHEMICAL PRODUCTS CO.
Dept. P.P.E., Towson 4, Baltimore, Md.



This header—a fine example of engineering and shop prefabrication—was installed during a 24-hour shutdown. Ordinarily it would have been assembled on the site, involving a shutdown of as much as 10 days costing thousands of dollars in loss of time and production.

PUTTING *POWER* IN ITS PLACE . . .

Blaw-Knox Prefabricated Piping, Functional Hangers and Vibration Eliminators are in use where multiplied production for the war effort demands unremitting stability of power piping lines and speed of installation.

Power Piping is but one of many Blaw-Knox products. Blaw-Knox is intimately identified with quality equipment and engineering "know how" in the iron, steel and non-ferrous industries, in equipment for railroads, public utilities, the electronic and construction industries and industry in general. It has achieved leadership in engineering, designing and producing plants and equipment for the chemical and process industries.

As Blaw-Knox can serve you with prefabricated piping, so it can serve you—with products and engineering—in all the fields in which it is active. Perhaps we can help you with your present or future activities. We will be glad to discuss it with you.

BLAW-KNOX COMPANY

A PACEMAKER FOR AMERICAN INITIATIVE AND INGENUITY

3003 FARMERS BANK BLDG.
PITTSBURGH, PA.

Six Blaw-Knox Plants have been awarded the Army-Navy "E" for war-production excellence

LEWIS FOUNDRY & MACHINE DIVISION,
Rolls and Rolling Mill Machinery

POWER PIPING DIVISION,
Prefabricated Piping Systems

SPECIAL ORDNANCE DIVISION,
Bofors Anti-Aircraft Gun Mounts and Mechanisms

BLAW-KNOX DIVISION,
Chemical & Process Plants & Equipment, Construction Equipment, Steel Plant Equipment, Radio & Transmission Towers . . . General Industrial Products

CHEMICAL PLANTS DIVISION,
Chemical and Process Plants from laboratory to production

PITTSBURGH ROLLS DIVISION,
Rolls for Steel and Non-Ferrous Rolling Mills

UNION STEEL CASTINGS DIVISION,
Steel and Alloy Castings

NATIONAL ALLOY STEEL DIVISION,
Heat and Corrosion-Resistant Alloy Castings

MARTINS FERRY DIVISION,
Bofors Anti-Aircraft Gun Mounts

BLAW-KNOX SPRINKLER DIVISION,
Automatic Sprinklers and Deluge Systems

BUFLOVAK EQUIPMENT DIVISION,
Food Processing Equipment, Evaporators, Dryers, Distillation and Solvent Recovery Equipment, etc.

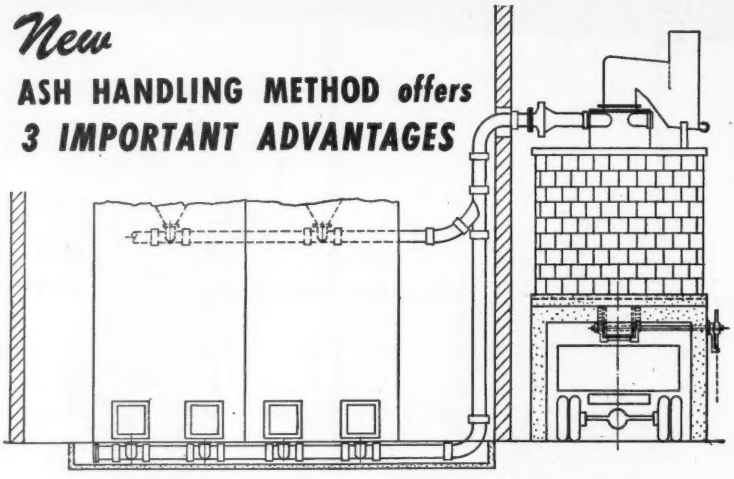
A FEW VICTORY PRODUCTS

ANTI-AIRCRAFT GUN MOUNTS · POWDER PLANTS · PIPING FOR NAVAL VESSELS
SYNTHETIC RUBBER PLANTS · GUN SLIDES · 14" PROJECTILES · LANDING BARGES
ROCKETS · CAST ARMOR FOR TANKS & NAVAL CONSTRUCTION · CHEMICAL PLANTS

New

ASH HANDLING METHOD *offers*

3 IMPORTANT ADVANTAGES



In the Beaumont "Vac-Veyor" pneumatic ash handling system the exhauster, receiver, separator and air washer are combined as one unit. Operating advantages include: (1) All ash delivered into the silo, none into the air. (2) Ashes delivered practically dry, which minimizes the possibility of packing or freezing in the silo. (3) Continuous operation, with low steam consumption. What are your ash handling problems? Send today for literature.

BEAUMONT BIRCH COMPANY

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DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

A New Time-Saver for Heat Engineers

THERMODYNAMIC PROPERTIES OF AIR

Including Polytropic Functions

By JOSEPH H. KEENAN and JOSEPH KAYE

The expansion of the science of heat engineering makes this new book increasingly valuable to mechanical engineers whose work involves heat problems. Here is provided a working table of the thermodynamic properties of air which will simplify many computations. The tabulated properties eliminate many laborious integrations. Interpolation can often be dispensed with, or greatly simplified.

SEE HOW THESE FEATURES WILL SPEED AND SIMPLIFY YOUR WORK:

Clarifies the one uncertain factor in the equation of state for air, T.

Provides a "steam table" for gas turbines and compressors—more convenient than a steam table.

Permits ready computation with allowance for variation in specific heat.

Eliminates guesswork from many calculations involving compressibility by providing pressure ratio functions convenient in many types of engineering computations.

Eliminates practically all interpolation by presenting Table I in minute detail. Even for greatest precision, no double interpolation is necessary.

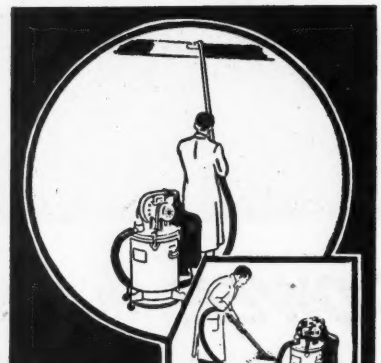
(1945) 80 pages $2.25

ON APPROVAL COUPON

JOHN WILEY & SONS, Inc.
440 Fourth Ave., New York 16, N. Y.

Please send a copy of Keenan & Kaye's THERMODYNAMIC PROPERTIES OF AIR on ten days' approval. At the end of that time, if I decide to keep the book, I will remit indicated price plus postage; otherwise I will return the book postpaid.

Name.....
Address.....
City and State.....
Employed by PPE-7-45



ALL-OUT

ATTACK Against Dust with TORNADO

KEEP dust "all out" with TORNADO—powerful, one-man portable Industrial Vacuum Cleaner. Its use insures quicker cleanups at less cost—floors, ceilings, walls, boiler tops. Gets rid of dust and dirt. Salvages scrap, flux, etc. Especially designed for industrial, heavy-duty type of cleaning. 1 h.p. G.E. universal motor. 49" waterlift, 175 c.f.m. Weight 40 lbs. 12-gal. tank. Outside bag. Costs less than 3c an hour to operate.

Request details and FREE TRIAL offer

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TAKE THE DUST OUT OF LIFE — TORNADO

VIKING

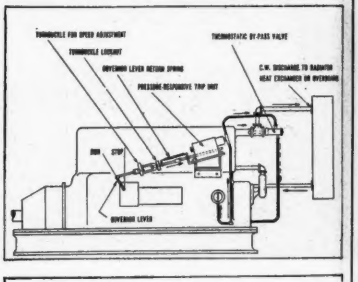
DIESEL ENGINE "SHUT-DOWN" SAFETY CONTROL

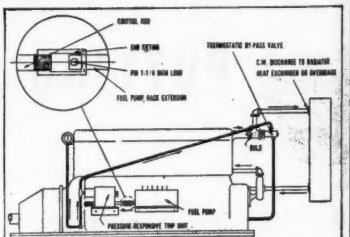
The Viking Type R-18 Shut-Down System for Diesel Engines, is a unique mechanically-operated safety control to shut down a diesel engine when (1) lubricating-oil pressure becomes too low, or (2) circulating-water temperature becomes too high.

Since it is mechanically operated this system does not require any electrical connections, and is free from operating failure due to blown fuses or other failure of electrical power sources.

A pressure-responsive bellows unit is connected in the lubricating-oil line and operates by trigger action a governor lever which shuts down the engine as soon as lubricating-oil pressure reaches the critical low point; similarly, a thermostatic by-pass valve in the circulating-water system will operate the lever when temperatures become excessive. Write for Data Sheet R-18.

TYPICAL APPLICATIONS





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PRESSURESTATIC AND THERMOSTATIC CONTACT MAKERS

COMPLETE ALARM SYSTEMS

WALL-MOUNTED VISUAL INDICATORS

TACHOMETERS

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403 Fairfield Ave. **Stamford, Conn.**

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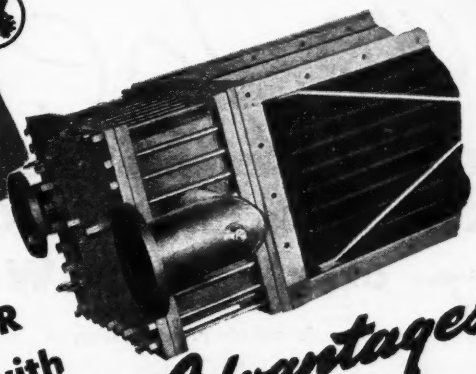
K-FIN



the GENERATOR AIR COOLER with 9 Important Advantages

1. **LASTING TIGHTNESS** . . . assured by patented Multigroove roller expanded packless tube joints at both ends
2. **LOW INSTALLATION COST** . . . permitted by compact design, requiring only simple piping and duct work
3. **FREE EXPANSION AND CONTRACTION** . . . permitted by the flexible tubing insert between shell frame and floating tube sheet
4. **MAXIMUM HEAT-ABSORBING SURFACE** . . . provided by the patented helical K-Fin heat transfer surface which greatly increases the exterior area of the tubes
5. **CONVENIENT ACCESS** . . . permitted by readily removable cover plates at each end for inspection and cleaning.
6. **CONVENIENT TUBE REPLACEMENT** . . . individual tubes can be withdrawn without disturbing adjacent tubes
7. **RIGID CONSTRUCTION** . . . support plates hold tubes in correct position throughout their entire length, and design eliminates tube vibration
8. **LOW AIR PRESSURE LOSSES** . . . provided by generous tube spacing
9. **EFFICIENT WATER DISTRIBUTION** . . . assured by simple multi-pass water heads which also provide efficient use of allowable water pressure drop

Write for Bulletin 1219 describing these units in detail.

ONE OF A SERIES OF ADVERTISEMENTS DESCRIBING THE MANY TYPES OF G-R HEAT TRANSFER APPARATUS

G-R BUILDS ALL THESE UNITS FOR HEAT TRANSFER SERVICE . . .

Evaporators
Stage Heaters
Gas Coolers
Drain Coolers
Aftercoolers
Air Preheaters
Fuel Oil Heaters
Jacket Water Coolers
Process Heat Exchangers
Transformer Oil Coolers
Generator Air Coolers
Lubricating Oil Coolers
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THE GRISCOM-RUSSELL CO.
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Sure Joe*...

NALCO Has a Chemical that Will Keep Scale and Scum Out of Compressor Water Jackets

but... it is the whole Nalco system of water treating that does the job. Cleaning scale and scum from the inside of the water jackets of horizontal compressors is not an easy job. It is much better to prevent it from forming in the first place.

You would not attempt to build a house with just a hammer . . . it takes many tools and a thorough knowledge of construction. So it is with water treatment, Joe—it takes more than just one chemical. Your water service engineer needs to have available a wide range of water treating chemicals to choose from, *plus* a complete follow-through program to solve the various water treating problems throughout industry. *Nalco provides this!*

Ask for a Nalco survey today.

Says
Grant Sievertsen
Nalco Representative,
Knoxville, Tennessee

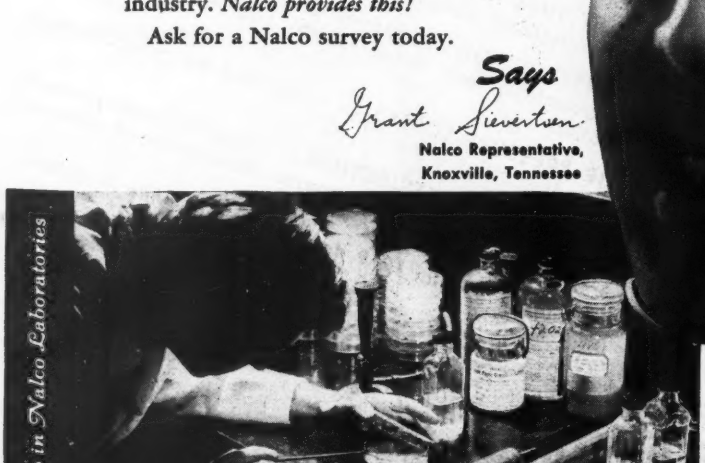
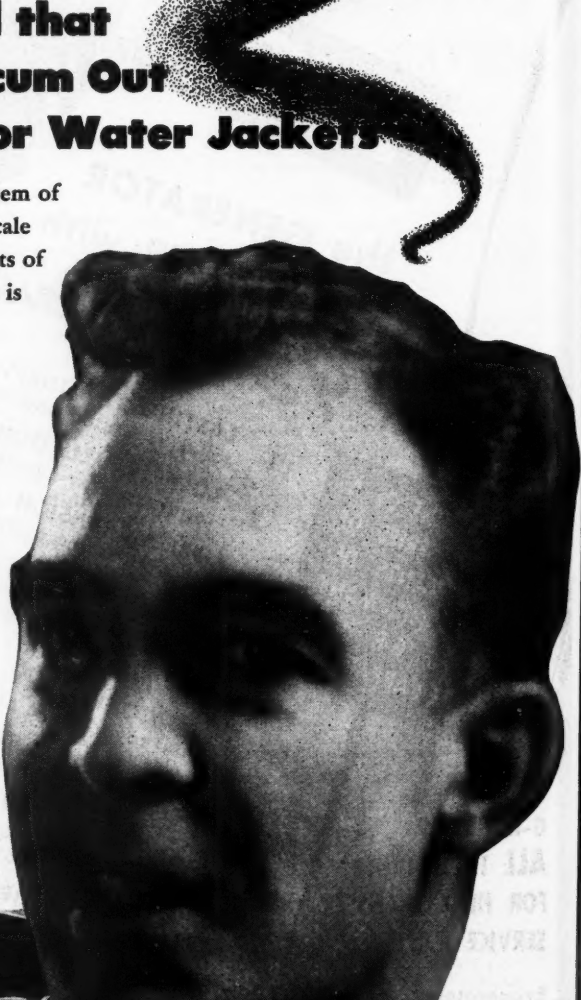


Photo in Nalco Laboratories



* Chief Engineer Joe, says—*Even with a "hand hole" on each side of the water jacket it is still difficult to clean out the scale and scum. We were wondering if anyone had a chemical which would keep scale and scum out of the jacket.*

Source: Survey conducted by a well-known power publication.

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to
Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto, Ontario

Nalco — System of Scientific Water Treating Service... for all industry

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILER PLANT

1 **Liquid and Gas Fuel Burners**—Bulletin OB-37, 16 pgs. shows a variety of types of oil and gas burners. Also liquid fuel pumping and heating equipment of various sizes to handle all types of fuel oil or tars to meet any capacity for all types of burners. The Engineer Co.

2 **Protection for Boiler Settings**—Bulletin B-341 explains how Bernitz air-cooled super blocks prolong the life of boiler settings, do away with furnace operating troubles brought about by clinker adhesion and slag erosion. Contains thermal conductivity of refractory tables, installation photos and other useful data. Bernitz Furnace Appliance Co.

3 **Coal and Ashes Handling Data**—Jeffrey Catlog 778 describes and illustrates the operation of bucket elevators, skip hoists, belt elevators, weigh larries, silo storage systems and other coal and ashes handling equipment. Offers capacity tables, specifications, engineering data. The Jeffrey Mfg. Co.

4 **Fuel Economics Affecting Power Plant Design**—Panel discussion on this subject takes up ash fusion, coal grindability, moisture and other factors bearing on use of most economical coals available. Reviews improvements in combustion equipment indicates how new plants can be designed for wider fuel flexibility. Fairmont Coal Bureau.

5 **Oil and Gas Burners**—A new bulletin, No. 902, describing the Peabody Type M gas burner and the combined gas and oil burner has been published by the Peabody Engineering Corp. It illustrates the mechanical and operating features of these burners, for natural or forced draft operation, also shows the types of atomizers used for oil firing.

ELECTRICAL

6 **Motors for Hazardous Locations**—What are hazardous locations? how to apply explosion-proof motors; requirements for distribution and wiring, are among topics covered in new Bulletin GEA-4131. Contains many motor application photos. General Electric Co.

7 **Electronic Heaters**—Application of Allis-Chalmers vacuum tube electronic heaters for both induction heating of metals and dielectric heating of nonmetallic materials is explained in a well-illustrated 4 pg. bulletin. Illustrations of typical production set-ups of the standard 20 kw. heater are shown. Features include a low-loss coupling system to provide adaptability in most applications without the use of radio-frequency transformers. Allis-Chalmers Mfg. Co.

8 **Drafting Room Lighting**—The finish of walls and floors, choice and spacing of lighting units, and other factors that provide good seeing conditions in drafting rooms are treated in publication "Architext." Holophane Co., Inc.

9 **Electronics Booklet**—New 48 pg. Industrial Availability Booklet shows electronic items available on priority for immediate delivery from stock. Includes tubes, test equipment, electrical maintenance supplies, timers, relays, constant voltage transformers, rectifiers, demagnetizers, tachometers, condensers, resistors, industrial switches, photo-electric units, fluorescent lamps. Walker-Jimieson.

10 **Plant Communication System**—Folder tells about Convers-O-Call intercommunication and paging system for power and industrial plants. Easily installed, cuts inter-office trips, saves productive time. Fred E. Garner Co.

11 **New Electrode Handbook**—56 pg. Airco book contains a combined electrode selector chart and index, illustrated sections on Mechanical Properties and Testing and on Approvals. Also describes Airco electrodes for welding mild steel, alloy steels, stainless steels, galvanized sheet steel, aluminum and other non-ferrous metals and for hardfacing; plus details of applications, welding procedure, mechanical properties, chemical analyses and specifications. Reference section offers information on such subjects as "Plate edge preparation," "Estimating electrode requirements," "Welding symbols," and "Glossary of welding terms." Air Reduction.

12 **Electronic Equipment Maintenance**—Westinghouse booklet Hints on Electrical Maintenance, Section 21, discusses cleaning, inspection, adjusting, etc., of vacuum tubes, capacitors, resistors, relays and other electronic equipment. Many helpful illustrations of maintenance techniques. Westinghouse Electric Corp.

FANS, PUMPS, COMPRESSORS

13 **Boiler Feed Pumps**—Features, sizes and capacities of Warren horizontal duplex plunger pumps for boiler feed and pressure service are given in new Bulletin 239. Maximum working pressure at steam end—200 lb.; at liquid end—350 lb. Warren Steam Pump Co.

14 **Compressed Air Handbook**—New 24-pg. two-color booklet entitled, "A Little Air Power Will Do Many a Big Job" contains useful handbook data. Nearly 70 photographs shows how to use compressed air for starting engines, spraying paint or insulation, metallizing, driving pumps and doing many other jobs around the plant. Ingersoll-Rand Co.

15 **Oil Lubricated Turbine Pumps**—New bulletin with large sectional drawing describes solenoid oiler, enclosed impellers, automatic clutch and other features of Fairbanks-Morse turbine pumps. Includes table of sizes and rates, other useful pump data. Fairbanks, Morse & Co.

16 **CO_2 Compressors**—Bulletin C-1100-B24 describes operating features and application of Worthington complete CO_2 plants for the production of CO_2 gas, liquid and dry ice. Contains typical installation photos. Worthington Pump & Machinery Corp.

INSTRUMENTS AND CONTROLS

17 **Industrial Thermometers**—Booklet describes various types of H-B industrial indicating and recording thermometers. Includes temperature ranges, instructions for ordering, other useful data. H-B Instrument Co., Inc.

18 **Regulator Engineering Data**—Leslie Catalog of Engineering Data No. 400, contains indexed bulletins on reducing valves, pressure controllers, pump governors. Also table on properties of saturated steam and other data for use in engineering computations and sizing regulators. Leslie Co.

19 **Midget Insulation Tester**—Bulletin 1785 gives description and specifications of The Midget "Megger" insulation tester. Weighs but 3 lbs., reads up to 50 megohms, delivers 500 v from hand-cranked generator. James G. Biddle Co.

20 **Electrolytic Conductivity Measurements**—To describe instruments for making precise conductivity measurements, the Leeds and Northrup Co. has revised it catalog, "Apparatus for Electrolytic Conductivity Measurements in Laboratory and Plant." Illustrates a signalling conductivity controller and several new industrial cells available since the earlier edition was issued.

21 **Smoke Indicator**—Folder describes the Diamond smoke indicator which enables fireman to see flue gases without leaving the floor. May be applied on any boiler; does not interfere with dampers; has no moving parts. Diamond Power Specialty Corp.

22 **Spectrometer for Industrial Research**—New 8 pg. booklet discusses the theory of X-ray power diffraction, how the Norelco spectrometer works, its performance and applications. Photos, diagrams and curves are used to illustrate text matter. In studies of engine wear and lubrication, this spectrometer identified deposits on filters and bearings; with boiler scale, it identifies many silicate and phosphate scales. North American Philips Co., Inc.

23 **Automatic Control Valves**—Asco solenoid valves for the automatic and remote control of the flow of liquids and gases are fully described in Bulletin No. 200 issued by Automatic Switch Co. Shows application photos fuel lines to Diesel engines and oil burners, pumps, etc.

24 **Electric Tachometers**—Bulletin GEA-4324 describes the features and advantages of GE electric tachometers for measuring rotational speeds from 1 to 60,000 rpm. Also includes tips on selecting tachometer equipment, schematic diagrams and other useful information. General Electric Co.

MECHANICAL TRANSMISSION

25 **Self-Lubricating Bearings**—New file folder tells about temperature limits, chemical resistance, compressive strength and other characteristics of Morganite self-lubricating bearings. Applications include liquid and gas pumps, hot water circulators, clutches, fans and blowers. Morganite Brush Co.

26 **Rubber Products for Industry**—Fifth edition of "Manhattan Rubber Products for Industry," a condensed catalog of mechanical rubber goods, has been completed by The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc. Particular emphasis is given transmission and conveyor belting, V-belts, hose, packing, molded rubber products, rubber roll coverings, tank linings, and abrasive wheels.

27 **Motorized Speed Reducers**—Philadelphia Gear Works is offering a new 52 pg. catalog, No. MR-45, which describes their entire line of self-contained motorized speed reducing units. Built in a wide variety of sizes and ratios, in both horizontal and vertical types. Complete engineering data is contained in this new catalog.

28 **Engineering Handbook on Gears**—New Bulletin AQA for the first time presents complete engineering data, comparative performance curves, design details, operating speeds and other data on Foote Bros. Aircraft Quality Gears for applications requiring high efficiency, compactness, light weight, low noise level. Foote Bros. Gear and Machine Corp.

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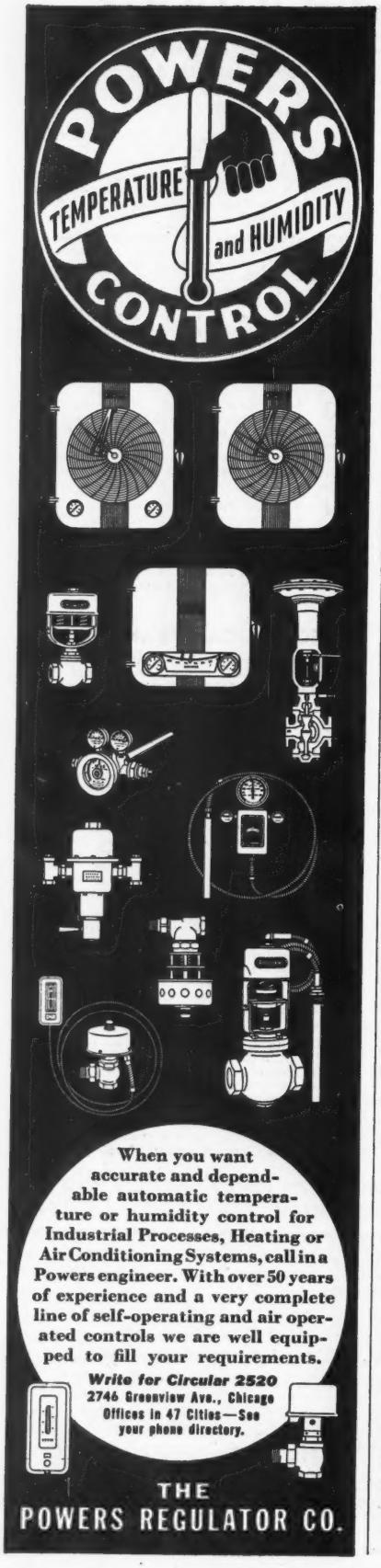
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29 **Flexible Shaft Handbook**—Power drive applications for air conditioning equipment, electrical portable tools, indicator mechanisms, hoists, tube cleaners and other machinery are described in new 256 pg. flexible shaft handbook issued by S. S. White. Contains many useful charts, operating diagrams.

30 **Portable Belt Vulcanizer**—The B. F. Goodrich Co. has published a new catalog section on portable electric vulcanizers for splicing rubber belts. Describes construction features of each belt vulcanizer in the line; table giving dimensions on each vulcanizer, number and dimensions of platens, widest belt which can be spliced in it, and wattage consumed.

PIPING

31 **Handbook of Branch Pipe Outlets**—This 32 pg. pocket-size manual explains the four simple steps in installing full pipe strength outlets by the WeldOlet method. Also illustrates tools needed to make the joint, three types of WeldOlet fittings available for butt-welded, threaded and socket-welded branch pipes, and shows typical installations. Bonney Forge & Tool Works.

32 **Prefabricated Piping** — Bulletin 526 tells about the advantages of Ebko prefabricated mechanically sealed conduits, prefabricated jacketed pipe, fittings, valves, etc. Contains diagrams and dimension tables. Ebko Products.

33 **Hose Coupling Handbook**—Described in 48-pg Catalog No. 644 is the complete line of Le-Hi high and low pressure hose couplings. Hints on the selection and care of couplings make this a useful reference book for engineers and maintenance men. Hose Accessories Co.

34 **Pipe Bending Data**—Folder describes the American hand-operated machine for bending all pipe sizes from 1¼ to 6 in. inclusive; motor operated machine, ½ to 8 in. inclusive. The American-Pipe Bending Machine Co.

35 **Working Pressures for Welding Fittings**—Tables for figuring allowable working pressures for Tube-Turn welding fittings in power, oil, district heating, gas and air, refrigeration piping are given in useful 18 pg handbook. Tube Turns, Inc.

36 **Pipe Welding Service** — Folder explains why the specialized know-how of an experienced pipe fabricator insures uniform sound welding; describes preheating and stress relieving, other tested procedure in welding shop of Cornell & Underhill, Inc.

37 **Air Saver Blow Guns** — New 24-pg catalog describes Lonn Air Saver blow guns, Air Saver spray guns and water savers, with physical specifications and tips on where and how to use them. There are no springs, levers, push-buttons or packing to wear out or require adjustment; valves are smooth, projection-free. Lonn Mfg. Co.

38 **Drop-Forged Flanges** — New catalog tells about the complete line of Phoenix flanges drop forged from a mild steel especially suited to welding and machining. Gives detailed specifications, sizes, dimensions; provides a handy guide in selecting flanges for any purpose. Phoenix Mfg. Co.

PRIME MOVERS AND ACCESSORIES

39 **Steam Turbines**—New catalog 1181, complete De Laval line of steam turbines, centrifugal pumps, centrifugal compressors, worm gear speed reducers, and IMO oil pumps. De Laval Steam Turbine Co.

40 **Diesel Engine Handbook**—New booklet, with many photographs and cutaway drawings, describes automatic full-pressure lubrication, overhead camshafts, oil-cooled pistons and other features of Hendy Series 50 Diesel. Includes useful handbook data. Joshua Hendy Iron Works.

41 **Steam Condenser** — Bulletin No. 99 furnishes a diagram of operation of the Niagara Aero steam condenser and other helpful information. Niagara Blower Co.

42 **Stage Heaters**—Bulletin 277 describes the features of the G-R Stage heater, including the patented enveloping baffle which permits heating boiler feed water several degrees above the dry and saturated temperature of extraction steam. The Griscom Russell Co.

43 **Steam Engines**—Data book describes operating features of Troy-Engberg steam engines for driving power plant and processing equipment. Troy Engine & Machine Co.

(Continued on page 198)

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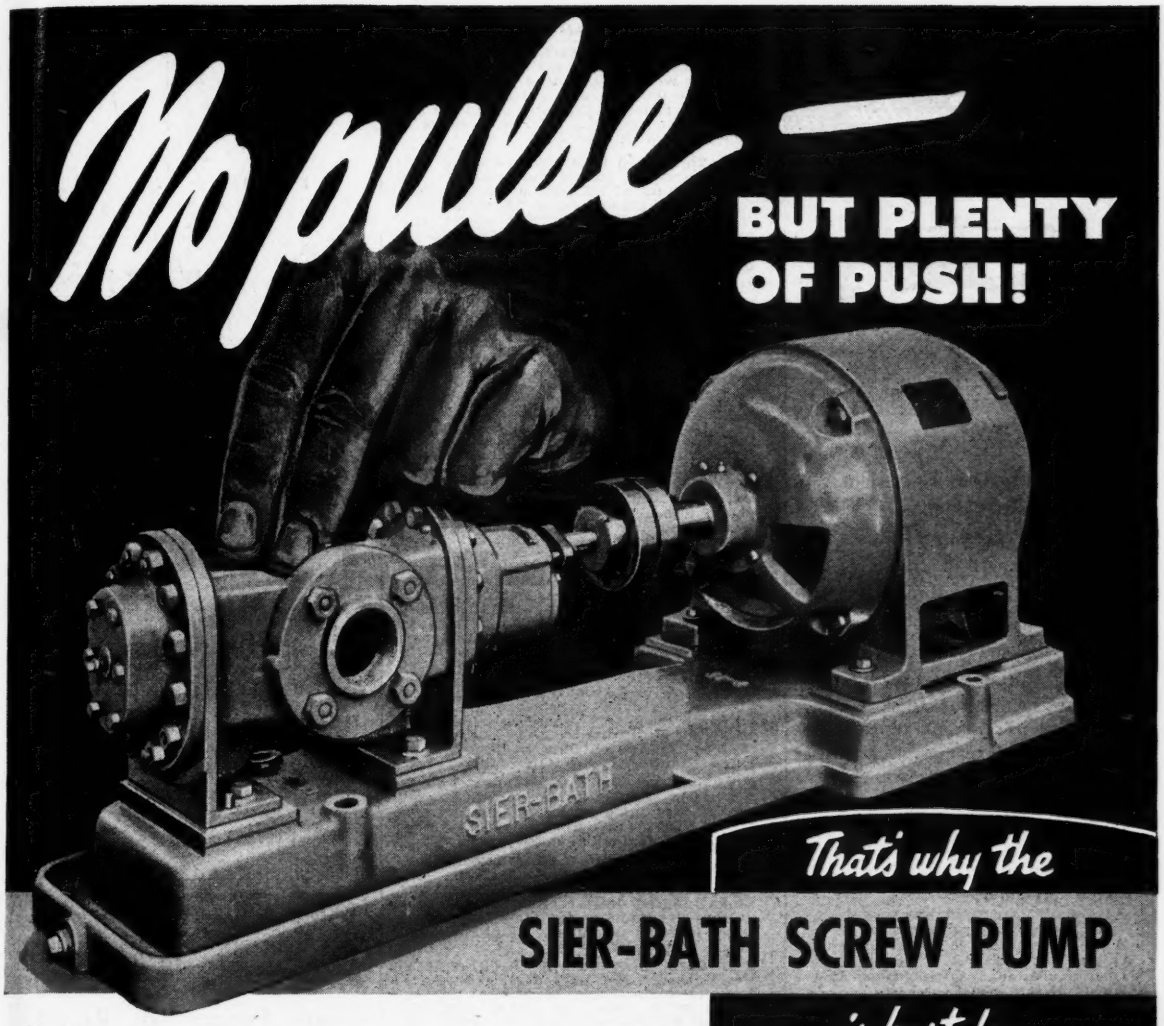

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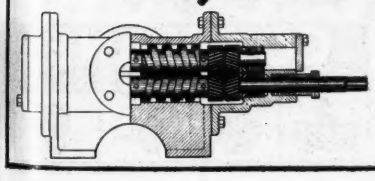

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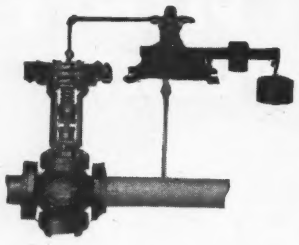

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MISCELLANEOUS

44 Non-Extrusion Packing—Described in a new folder are the nine design features of Weathered T-Ring packing which is said to do away with extrusion damage. Has been tested at pressures up to 300 psi; available in two types and wide range of sizes. The Weathered Co.

45 Force Feed Lubricators—Catalog L-44 describes simple adjustment and other features of Hills-McCanna force feed lubricators. Provides data on sizes available, instructions for ordering; shows typical installation photos. Hills-McCanna Co.

46 Corrosion in Unit Heaters—New 12-pg booklet contains technical information under headings as "What is corrosion," "What prevents corrosion," "What metals are vulnerable to corrosion," "Selection of proper unit as important as machinery for production line." Contains illustrations of cast-iron "fin" type unit heaters and installation views. D. J. Murray Mfg. Co.

47 Water Filter and Grease Extractor—Illustrated folder describes the cleaning ease, low cost operation and other features of Blackburn-Smith filters for industrial and general service. Widely used for removing foreign matter from supply water for laundries, chemical plants, food plant; also filtering suspended lubricants from condensed exhaust returns. The Blackburn Smith Mfg. Co.

48 Packing Specification Chart—New 16 pg Quaker Packing catalog and specification chart provides helpful tips for maintaining stuffing boxes in steam, hot and cold water, brine, ammonia, oil and other services. Data is well organized, easy to use. Quaker Rubber Corp.

49 Rust-Preventive Oils—Well illustrated, 40 pg booklet tells where and how to use Shell rust-preventive oils to lubricate machinery wherever moisture is a factor. Protective coatings range from thin transparent oil films to heavy, abrasion-resistant surfaces. Shell Oil Co.

50 Stopping Wall Leaks—Illustrated bulletin tells how and where Flextite can be used to stop leaks and water seepage in basements, elevator pits, tunnels, dams, retaining walls, etc. Flexrock Co.

51 Induced Draft Cooling Towers—Bulletin No. 600 tells about the size, capacities, typical performance reports of Binks induced draft cooling towers. Used indoors or outdoors for air conditioning, water jacketed machinery, industrial processing. Binks Mfg. Co.

52 Data on Industrial Hygiene—Illustrated folder tells about Oakite Tri-San for maintaining sanitation requirements in factories and service establishments. In one operation it cleans, destroys odors, disinfects the surface; widely used in bakeries, cold storage plants, shower stalls. Oakite Products, Inc.

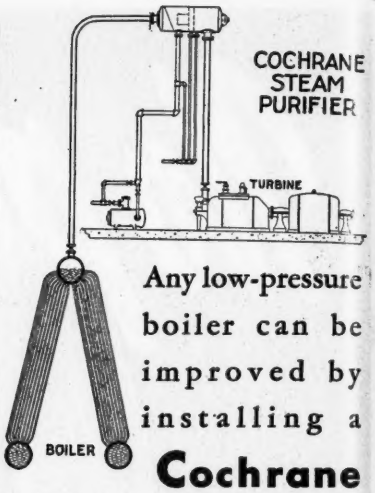
53 Metal-Asbestos Gaskets—Condensed catalog-type folder offers construction details and specification data for Ajax spiral wound gaskets. Includes boiler handhole, manhole, tubecap and other boiler accessory gaskets; self-centering gaskets; flange gaskets with solid steel reinforcing ring; manhole gaskets with wire guide; pressure groups up to 3500 psi. U. S. Gasket Co.

54 Floor Maintenance Problems—Illustrated folder pictures 15 different problems relating to the maintenance of floors and driveways in industrial plants; suggests a specific type of Stonhard for taking care of the ruts, cracks and leaks. Stonhard Co.

55 Chemical Scale Removal—Attractively illustrated booklet "More Power to America's Industry," describes the simplified Dowell chemical method of cleaning scale and sludge from boilers, condensers, engine cooling jackets and other heat exchange equipment. Contains results of typical Dowell applications. Dowell, Inc.

56 Aluminum Imagineering Notebook—Thumb-tabbed in a new 28-pg notebook are details on the light weight, corrosion resistance, high electrical conductivity, non-sparking, and other properties of aluminum. Also pictures many power plant applications such as stacks, bus conductors, cable, rotors, switchgear housings, process tanks. Aluminum Co. of America.

57 Hints on Plant Maintenance—How Lumnite, a special hydraulic cement, is used for wear resistant linings in ash pits, coal bunkers, steel stacks, baffles, etc., is explained in reprint of article "Deterioration and Maintenance of Power Plant Structures." Atlas Lumnite Cement Co.



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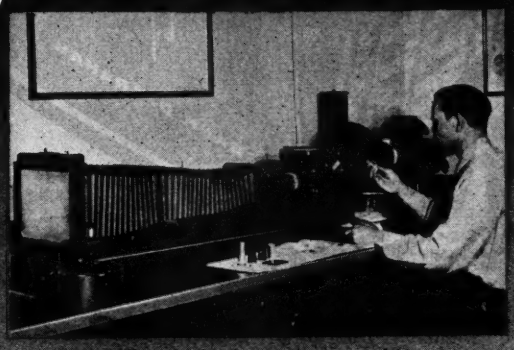

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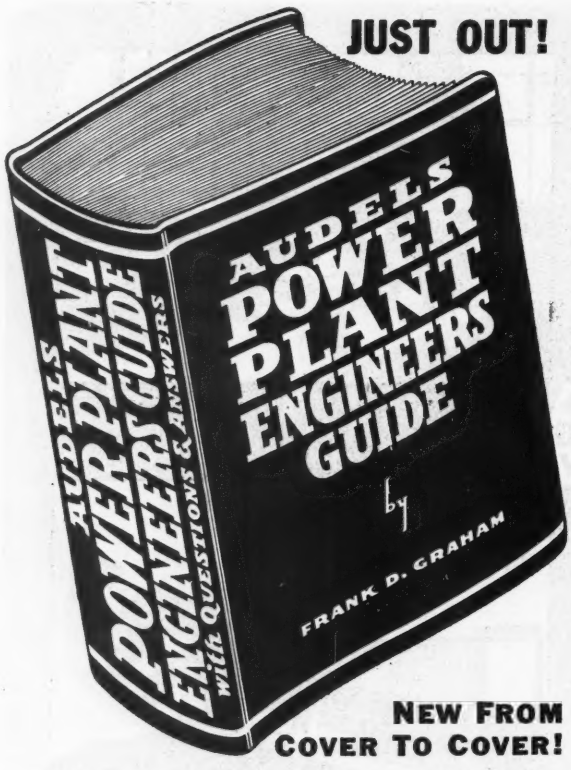

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POWER PLANT *Construction News*

Calif., Berkeley—Challenge Creamery & Butter Association, 896 22nd St., plans installation of electric power equipment in proposed new dairy products plant, to be carried out as a postwar project. A boiler house will be built. Cost reported over $400,000, with equipment.

Calif., Glendale—Public Service Department has been granted a priority rating for proposed expansion and improvements in municipal power plant on San Fernando Rd., with installation of new turbine-generator and accessories, boiler, cooling tower, etc., estimated to cost about $800,000. Plans will be completed soon and work placed under way.

Calif., Los Angeles—Union Ice Co., 1525 Industrial St., has plans for modernization of former ice-manufacturing plant at 3629 11th Ave., and will convert for a freezer unit. New refrigerating equipment and other facilities will be installed. Cost reported close to $53,000. A priority rating has been secured and work will be carried out soon.

Ill., Meredosia—Central Illinois Public Service Co., Springfield, Ill., has secured permission from WPB to proceed with construction of proposed new steam-electric generating station at Meredosia. Initial installation will comprise a 50,000-kw. turbine-generator unit, two high-pressure boilers and auxiliary equipment. Project will include extensions in transmission lines, including new line for connection with present station of company at Hutsonville, Ill. Entire development is estimated to cost about $10,000,000.

Ill., Venice—Union Electric Co. of Missouri, St. Louis, Mo., has secured authority from WPB for proposed expansion in No. 2 generating station at Venice, operated by Union Electric Co. of Illinois, to include installation of new 80,000-kw. turbine-generating unit, two high-pressure boilers with rating of 375,000 lbs. steam per hr., and auxiliary equipment. Also will make extensions in transmission and distributing lines. Entire program reported to cost over $5,000,000.

Ind., Nappanee—Nappanee Utilities Co., has plans in progress for expansion and improvements in steam-electric power plant, with installation of equipment for expansion in steam division, including boilers, stokers, coal-handling machinery and accessory apparatus. Cost reported close to $125,000.

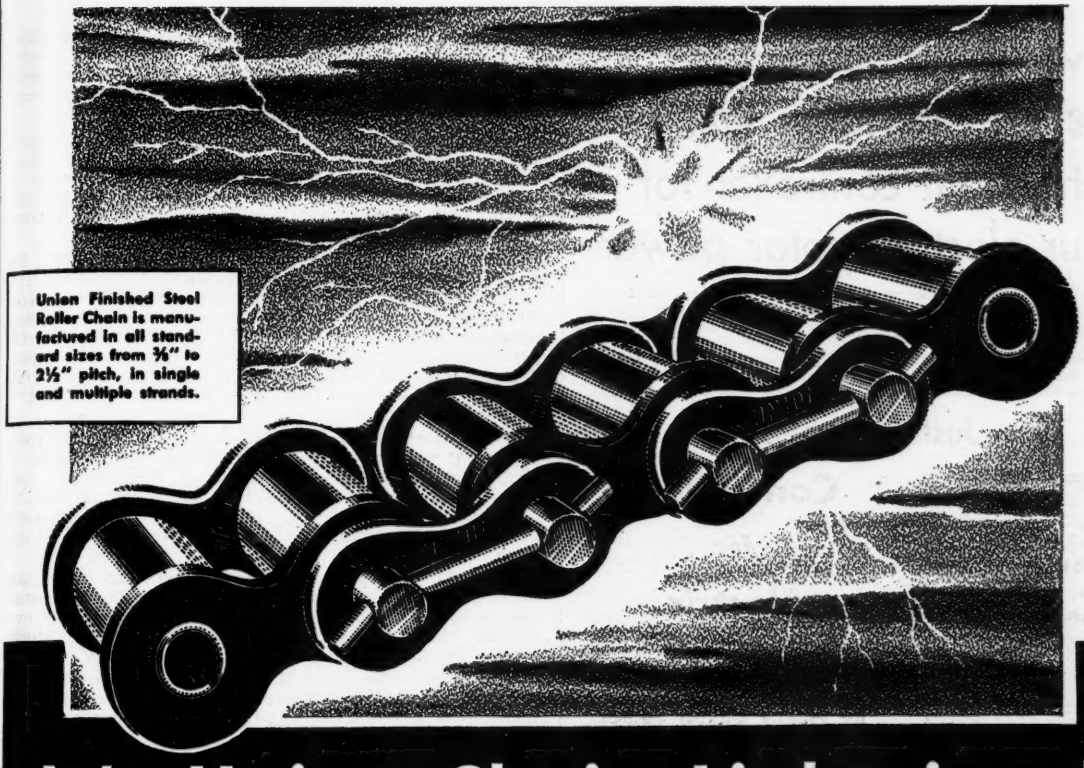
Ind., Richmond—Crosley Corp., 1329 Arlington Ave., Cincinnati, Ohio, radio apparatus, refrigerators, etc., plans expansion in refrigerator-manufacturing plant at Richmond as a postwar project, including large addition to main production unit. Electric power equipment will be installed. Cost reported close to $2,000,000.

Iowa, Carroll—Glidden Rural Electric Cooperative, Inc., Glidden, is arranging for purchase of an existing generating station in vicinity of Carroll, and will use for power supply for rural electric system. Extensions will be made, including installation of a 300-kw. generating unit and auxiliary equipment. Entire project will cost about $150,000. Financing has been arranged through Federal aid.

Iowa, Sioux City—Sioux City Gas & Electric Co., Sioux City, has secured a priority rating for proposed expansion in local Kirk generating station, including installation of a 7500-kw. turbine-generating unit, high-pressure boiler and auxiliary equipment. Extensions also will be made in transmission lines. It is understood that program will be carried out at early date.

La., New Orleans—New Orleans Public Service, Inc., New Orleans, plans extensions in Gentilly steam-electric station, with installation of new 37,500-kw. turbine-generator unit and accessories, high-pressure boiler and auxiliary equipment. Project has been approved by WPB and will be carried out in near future.

Mich., Flint—Chevrolet Motor Division, General Motors Corp., 3044 West Grand Blvd., Detroit, Mich., plans power plant in connection with proposed new assembling works at Flint, using portion of 100-acre tract of land near Flint city limits, recently acquired. Assembling plant will comprise several large units, approximating 1,000,000 sq. ft., with machinery and facilities, including electric power equipment, for large output. Project will be a postwar development and is reported to cost in excess of $6,500,000.



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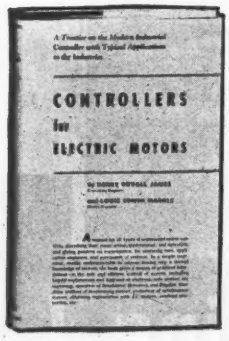

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CHAPTERS

Functions and Types of Control
How to Read Controller Diagrams
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Magnetic Contactors
Starting Characteristics of Motors with Different Methods of Control
Methods of Accelerating Motors
Methods of Speed Control
Control for Special Applications
Mechanical and Dynamic Braking
Regeneration
Voltage Control for Direct-current Motors
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Adjustable-speed Alternating-current Motors of the Wound-rotor Type
Types of Resistors
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Future Control Developments

Detailed information on:

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Mich., Monroe—Monroe Auto Equipment Co., automobile parts and specialties, plans installation of electric power equipment in new one-story addition, to be carried out as a postwar project. Cost about $125,000, with machinery. B. D. McIntyre is president.

Minn., Moorhead—Municipal Water & Light Department, 617 Center Ave., has tentative plans under advisement for expansion in municipal steam-electric generating station, including installation of a 3000-kw. turbine generator, boiler, stoker and auxiliary equipment. Proposed to arrange fund of about $110,000 for project.

Minn., St. Paul—Minnesota Mining & Mfg. Co., 900 Farquier Ave., cellulose products, roofing granules, etc., has plans maturing for new one-story addition, about 400,000 sq. ft. floor space, for manufacture of cellulose adhesive tape, with machinery for large output. Electric power equipment will be installed. Project will be a postwar development, and is reported to cost over $2,000,000. Toltz, King & Day, Inc., Pioneer Bldg., St. Paul, is architect and engineer.

Miss., Hattiesburg—Mississippi Power Co., Gulfport, Miss., has preliminary plans under way for expansion in steam-electric generating station on Leaf River, near Hattiesburg, known as Plant Eaton, forming second unit of plant. Installation will include a turbine-generator unit, boiler and auxiliary equipment. No estimate of cost as yet announced.

Ohio, St. Marys—St. Marys Woolen Mfg. Co., plans installation of electric power equipment in new two-story mill addition, about 75 x 110 ft., reported to cost over $85,000, with machinery. Project will have a priority rating. Lyman Strong, Lima, Ohio, is architect.

Ohio, Tiffin—American Radiator & Standard Sanitary Corp., Tiffin, plans installation of electric power equipment in new one-story addition to local vitreous china plumbing fixture plant, about 120 x 400 ft., reported to cost over $180,000. Project will be carried out at a postwar development or as soon as equipment and materials are available. Main offices are in Bessemer Bldg., Pittsburgh, Pa.

Okla., Tulsa—Public Service Co. of Oklahoma, Tulsa, plans expansion in local steam-electric generating station, with installation of a 20,000-kw. turbine-generating unit, high-pressure boiler with rating of 250,000 lbs. of steam per hr., and auxiliary equipment. A priority rating has been secured. Company is planning a postwar expansion program for transmission and distribution lines, including about 250 mi. of rural electric system. It is understood that a fund of about $5,000,000, is being arranged for entire development.

Pa., Emlenton—Quaker State Oil Refining Co., Oil City, Pa., has plans under way for extensions and improvements in boiler plant at Sterling Oil Division plant, Emlenton, including installation of additional equipment for increased capacity. Cost reported over $100,000, with equipment.

Pa., Midland—Crucible Steel Co. of America, Inc., Midland, plans installation of electric power equipment in new one-story addition to local mill, reported to cost over $400,000. Project will have a priority rating. Main offices of company are at 405 Lexington Ave., New York, N. Y.

Pa., Pottsville—D. G. Yuengling & Son, Inc., plans new boiler house at local brewery, with installation of boilers and auxiliary equipment for large capacity. Cost reported close to $80,000, with equipment. Albert C. Wood, Stock Exchange Bldg., Philadelphia, Pa., is consulting engineer.

Texas, Denton—Water and Light Department, North Elm St., plans expansion and improvements in municipal power plant, with installation of additional equipment for increased output. Also will make extensions in primary and secondary lines, with service connections and other operating facilities. Proposed to arrange fund of about $800,000 for program.

Wash., Naches—Pacific Power & Light Co., Portland, Ore., plans rebuilding of portion of hydroelectric generating plant at Naches, recently damaged by fire, with loss reported over $100,000, including equipment. It is understood that a priority rating will be secured.

Wis., Racine—Twin Disc Clutch Co., 1328 Racine St., Racine, clutches, power take-off units, etc., plans installation of electric power equipment in new one-story addition, about 25,000 sq. ft. floor space, reported to cost over $100,000, with equipment. Application has been made for a priority rating. Frank J. Hoffman, 201 Sixth St., Racine, is architect.

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Here is a duplex strainer which does a thorough job of removing dirt and other foreign matter from oil, water and other liquids, *yet is moderately priced.* Design simplifications, standardization and construction economies all contribute to making this new strainer outstanding in many ways.

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allow continuous flow while cleaning. Dirt is collected in the basket which is easily removed without loss of fluid. Strainer free area is a minimum of 5 times pipe area.

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nut-and-stud type, easy to adjust and will not corrode and "freeze."

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on basket chambers for draining fluid from unit.

Made of cast bronze, these SK Duplex Strainers are designed for pressures up to 125 psi, in pipe sizes from ½ to 2 inches. Being light-weight, they need no support other than the pipe line.

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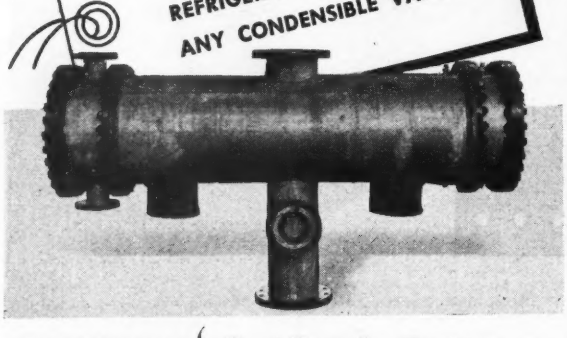

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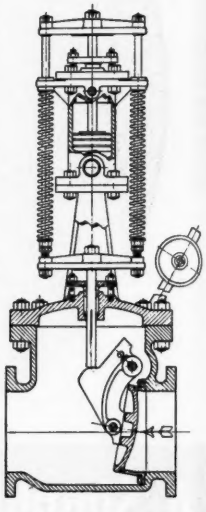
Davis Turbine Bleeder Non-Return Valves with auxiliary oil cylinder close automatically in case of oil system failure, overspeed or reverse flow. Action of auxiliary oil cylinder and "hammer-blow" effect of spring pressure assure quick, sensitive action, and positive closure.

Davis Non-Return Valves are simply constructed; flow resistance and pressure drop are minimized. There is *immediate* valve action if flow is reversed. Outside counterweight lever gives visible action—affords a ready means of hand testing.

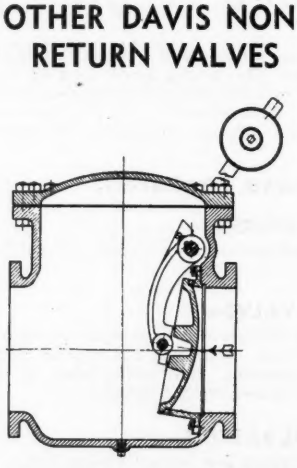
Bulletin No. 101A describes Davis Back Pressure, Exhaust Relief, Stop and Check, Non-Return and Relief Valves. Ask for it. DAVIS REGULATOR COMPANY, 2508 S. Washtenaw Ave., Chicago 8, Illinois.



Straight flow type turbine bleeder non-return valve with oil control cylinder mounted above valve.

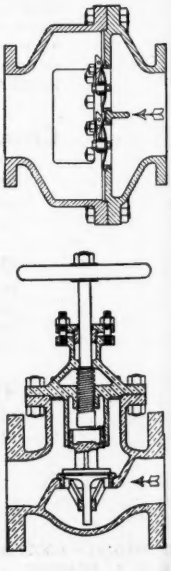
Below—Davis Multi-Disc Non-Return Valve. For pressures up to 25 lbs.—very slight flow resistance—minimum pressure drop.

OTHER DAVIS NON-RETURN VALVES



Above — Davis No. 134 Balanced Check Valve — Counterbalanced straight flow type.

Right—Davis No. 105 Screwdown Check Valve. Internal dash pot—through bolted bonnet—bronze body—renewable seat. Can be closed same as a stop valve.



Not Acids...Alkalies...Abrasives nor Suspended Solids can Corrode, Abrade or Jam this

NEW DIAPHRAGM VALVE

McALEAR NO. M-1455 Corrosion and Abrasive Proof Diaphragm Valve. Pressures to 150 lbs. Temperatures to 150° F. Sizes ½" to 6"

This valve—not yet 1 year old—has already replaced more expensive valves in a goodly number of chemical plants, industrial plants, mines, sewage disposal plants, water works, paint factories, paper mills, food processing and other industries. It has proved practically indestructible in service with upwards of 100 acids, alkalies, abrasives and suspended solids.

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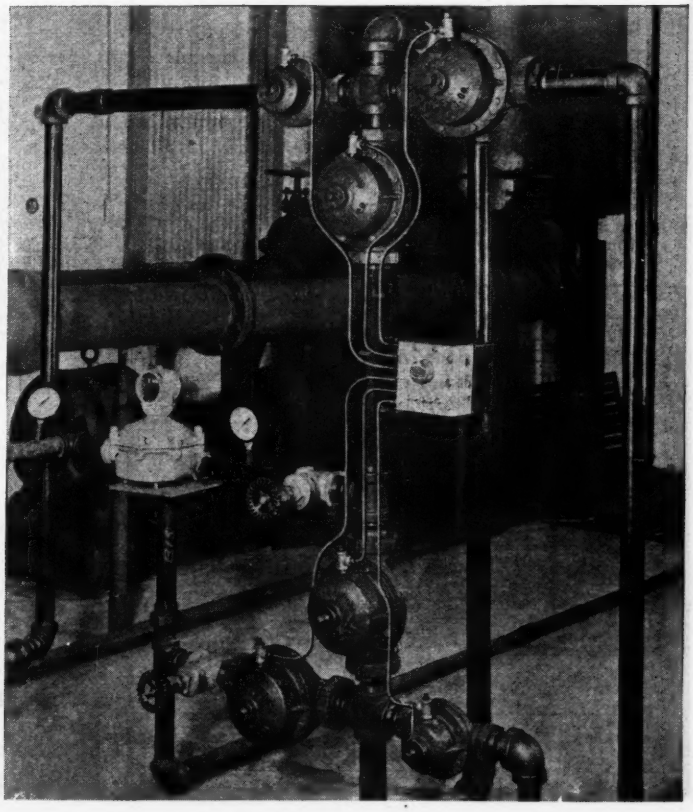
THIS VALVE cannot freeze in outdoor service—has no stuffing box—requires no repacking. It does not depend on metal-to-metal contact for closure. Hence *cannot* leak and *never* requires reseating. Positive shut-off is provided by diaphragm—*even* when solids are trapped on the seat.

Installable *in any position* without danger of leaks. Special types may be operated from remote points by air or water pressure, controlled by automatic time-clock or pilot. For Diaphragm Valve Bulletin giving complete data, write Automatic Control Division, Climax Industries, 1915 S. Western Avenue, Chicago 8.

Below: **PILOT OPERATED TYPE** controlling flow rate, backwash and rinse cycles in Mid-West industrial plant



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PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE

for STEAM, WATER, AIR, OIL—GAS

ARMORED FLOORS

CONCRETE floors disintegrate not only from abrasive wear due to heavy trucking, but also because of continuously wet conditions and attack by acids, oils and greases.

The quality of STONHARD STONPACH is such as to withstand abrasive wear and deterioration and to form a coat of armor on the surface of the floor itself.

In repairing busy factory floors, there is a limited amount of time in which the work can be done and in most cases it is inconvenient to move machinery and equipment. The use of STONHARD STONPACH for repairing ruts and holes in floors under these conditions provides the *easiest* and *quickest* way to re-establish a working area to profitable use.

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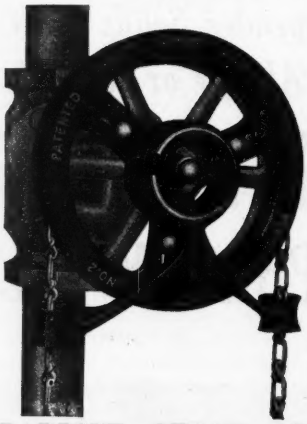

Stop climbing ladders to open and close those "high-up" valves. Equip them with Babbitt Sprocket Rims and you can control them quickly and safely from the floor. Babbitt Rims are easily attached and low in cost. They show real savings in time and steam—help guard against accidents. Now is the time to fit your overhead valves with Babbitt Rims. Write today for further information.

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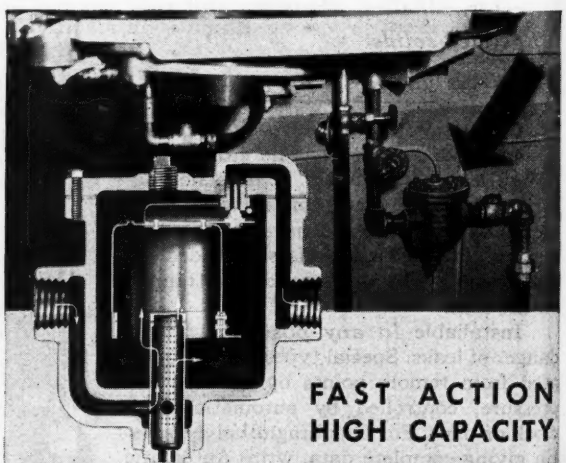
SPROCKET RIM
with Chain Guide



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This trap removes condensate from steam supply lines to pumps, engines, turbines and separators and is preferred by laundries, textile, and plastic industries. It can be adapted to the highest commercial steam pressures and temperatures and can be inspected without disturbing pipe connections. Integral strainer protects the mechanism. Sizes ½ to 2", pressures up to 900 lbs. Ask for Catalog No. 350.

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183

DESIGNING A HEAT-TIGHT WALL

It takes more than materials to design a heat-tight wall although each must be selected on the basis of their outstanding function—*refractories* for protection against the furnace gases; *insulation* to stop the flow of heat; *cast-iron members* for sectional support, and a *plastic* material, applied with a trowel, to provide a permanent, weatherproof casing.

It takes more than merely tying these four elements together although they must be so integrated that they will function as a single unit, yet allow enough flexibility to provide for wide ranges of temperature.

What it takes is the know-how that comes from first-hand knowledge—knowledge acquired over thirty years of engineering heat enclosures. And it's Detrick that has had this long background of experience.

A new 80-page catalog presents the Detrick principles of construction which have been learned the hard way, in a graphic form which will bring any engineer up to date on the important subject of heat enclosures. If you have a problem along these lines up at present or contemplate one in the future, send for your copy today.

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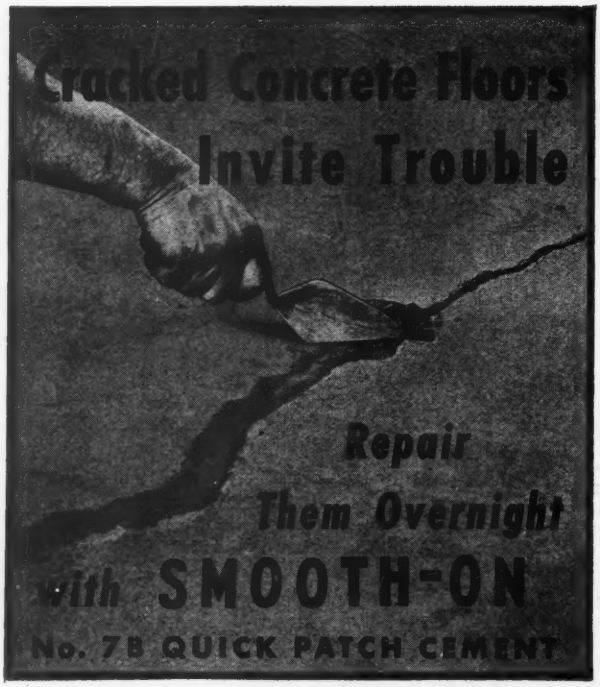

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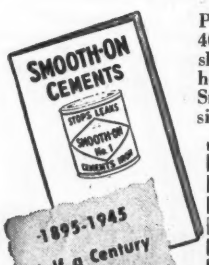

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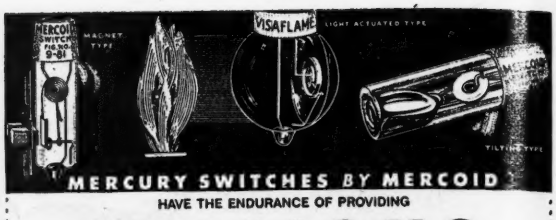

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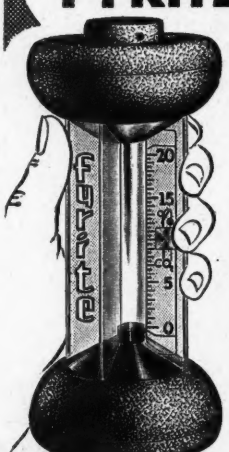

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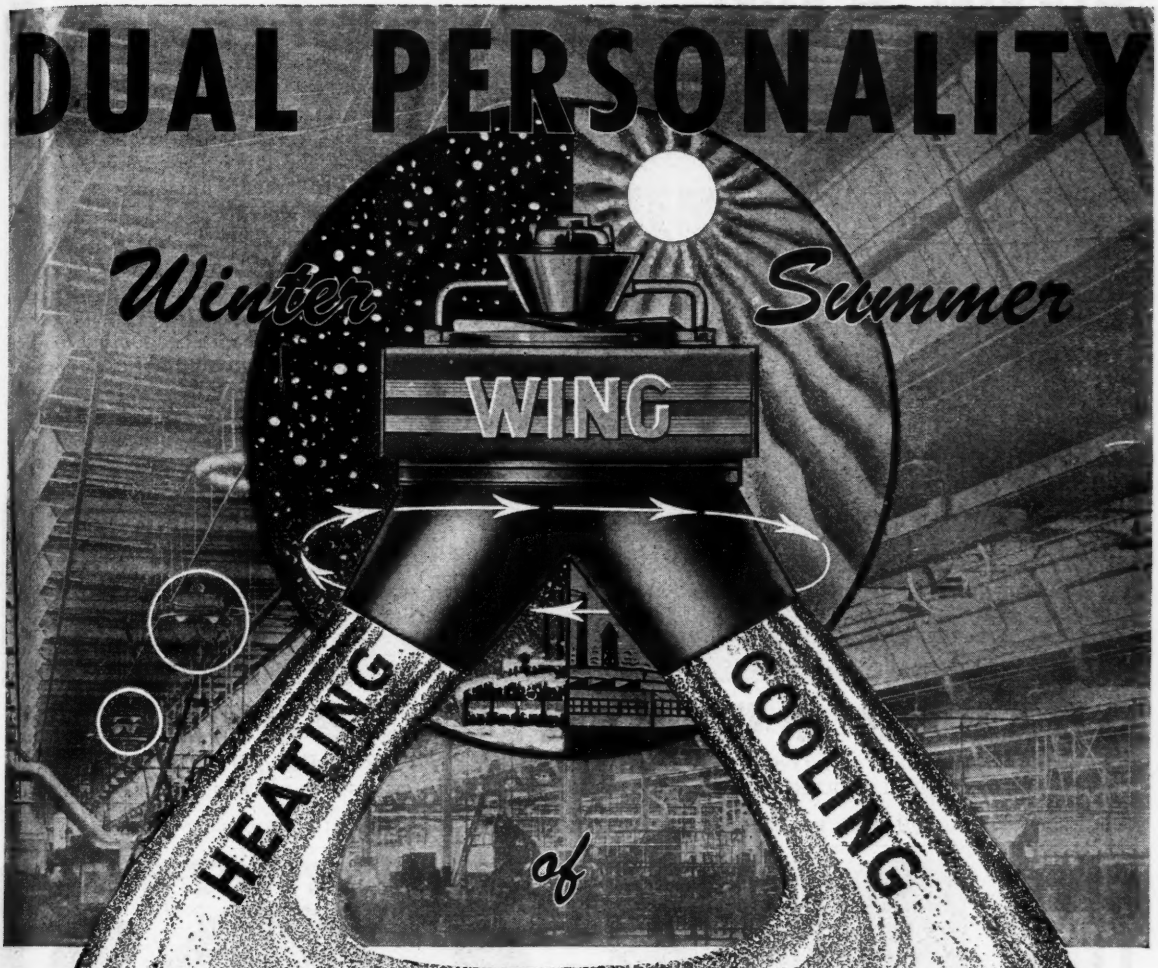

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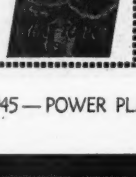

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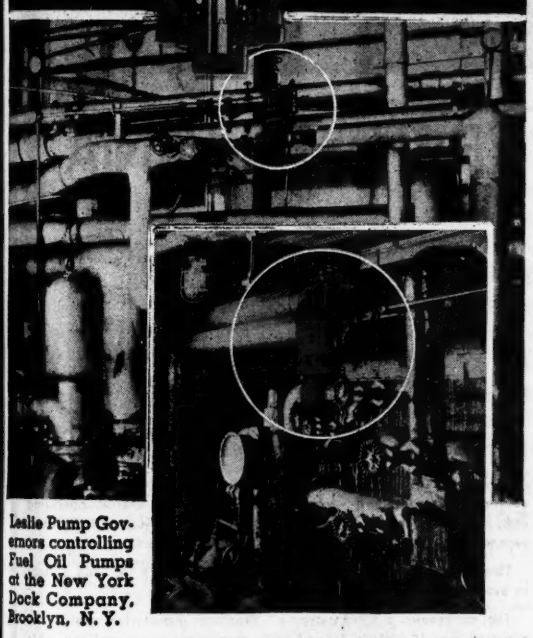
for Boiler Feed, Fuel Oil and Fire Protection Pumps Reciprocating or Turbine Driven

MECHANICAL TRANSMISSION of the slightest change in pump discharge pressure exerted on the metallic diaphragm at this point (1) through yoke (2) to the lower steam diaphragm and controlling valve results in an instantaneous steam pressure change to the piston-operated main valve and to the pump.

A LARGE CORRECTING FORCE is created by even a small pump pressure variation by the positive action of the controlling valve (3) employing high inlet steam pressure and the piston-operated main valve. Total diaphragm travel is small and only .001" to .002" movement will vary steam chest pressure to pump sufficiently to maintain constant discharge pressure.

THE operation of the Leslie Pump Governor is simple, smooth, and positive. The pump discharge pressure is easily adjusted or "set" by the convenient handwheel at the top, equipped with lock nut. After adjustment, the smallest variation in pump discharge pressure actuates the two diaphragms and the piston-operated main valve controlling the steam supply to the pump.

The Leslie Pump Governor thus automatically assures constant and positive pump discharge pressure during all load changes, and especially where fast, correcting action is required. Minimum maintenance, due to absence of stuffing boxes and bellows.



Leslie Pump Governors controlling Fuel Oil Pumps at the New York Dock Company, Brooklyn, N. Y.

This Company also uses standard Leslie Steam Pressure Reducing Valves, Leslie Pressure Controllers, and Leslie Diaphragm Regulating Valves.

FEATURES OF THE LESLIE PUMP GOVERNOR

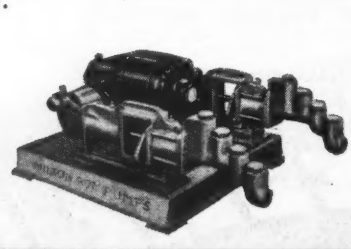
Self-contained. Single-seated. Monel Metal diaphragms (no bellows or packing glands). All wearing parts renewable without removing Governor from pipe line (100% interchangeability). The most corrosion and wear-resistant material obtainable (stainless steel hardened wearing parts and special heat resistant springs) is furnished as standard in all pump governors.

● ***Improved production facilities assure prompt shipment—most items 10 to 30 days***

FOR COMPLETE DATA BULLETIN 403A

New . . . **Bulletin on Boiler Water Chemical Treating Units . . . . . .**

- Tells how to protect boilers against corrosion and pitting . . . prevent scale, control alkalinity, remove dissolved oxygen.
- Tells how Sodium Sulfite should be fed . . . how other chemicals should be fed . . . why two systems are used in combination for best results.
- Describes simple, complete "Packaged" units to meet above requirements . . . a brand new Milton Roy development.
- Contains selection tables from which to choose units of proper capacity for single or multiple boilers operating over a wide range of pressures and make up water requirements.
- This bulletin is "must" reading for every power plant operating engineer. Send for it.



MILTON Roy PUMPS
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HOW **MAGIC** **BOILER PRESERVATIVE**
Guards 2 Ways Against Corrosion

Corrosion occurs when oxygen or acid gases act on metal. Oxygen and carbonic acid gas are found dissolved in all natural waters to a varying degree. Hydrochloric acid gas is formed under steaming conditions, when chlorides of iron, magnesium, calcium or sodium are present in feedwater. The liberation of hydrochloric acid gas from these substances is accelerated by the presence of sulfates of calcium and magnesium. Carbonic acid gas is liberated from bicarbonates of calcium and magnesium.

MAGIC Boiler Preservative acts in two ways to guard against corrosion. First, the MAGIC dissolved in the boiler water "binds" acid gases and represses their liberation. Second, the MAGIC film of protection keeps corroding substances from contact with the metal.

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In modern Central Station design, Engineers familiar with their accurate sizing, automatic refuse removal, and low overall operating cost, usually locate Bradford Coal Breaker and Cleaner Equipment, somewhere between the Track Hopper and the Bunkers.

There are over 50 of these installations in the U. S. A., and 3 more in process.

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The installed capacity of "Pennsylvania" Coal Preparation Equipment, at home and abroad, now approximates 300,000,000 tons per annum.

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COAL PREPARATION

Paste THIS in your handbook, Mr. Engineer!

IF your pressure line requires a SPECIAL Relief or Safety Valve—Farris engineers can provide the proper valve, or custom build one for you!

FARRIS Handwheel Relief Valve No. 1450, for frequent changes of relief pressures. Special construction to withstand excessive wear of continual adjustment. Sizes ½" to 8".

FARRIS Safety Relief Valve No. 2175. Full nozzle port, hi-lift. Steam Separator Bell. Pressures to 600 lbs. at 750° F. Sizes ¾" to 6".

FARRIS engineers have been called in on so many special valve jobs that we often wonder "WHAT NEXT!" Minor pressure technicalities and major valve engineering projects alike—we have built accurate, dependable safety and relief valves for *all* of them. Of course we're proud of that record—we are only human!

And as we designed and built those special FARRIS valves for new industries, new processes, new products . . . we added most of them to our regular line of valves. So today, it's a good bet that among the FARRIS collection of all types, sizes, and metals, there is *the very valve* which will exactly meet your requirements.

But if WE have *any* doubt about that, we will *custom build a valve especially for your job.* And we'll be glad to do it, because we may find that we can add your new FARRIS valve to our already extensive line . . . so we'll mutually benefit from your problem!

Now, don't you agree . . . that makes good business sense? *Why not write today for our Specifications Bulletin?*

FARRIS ENGINEERING COMPANY
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Write us today about any Safety or Relief Valve Problem confronting you. If you are lucky and do not have a valve headache now, GOOD! But paste this ad in your handbook for future emergencies.

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The men who are holding good jobs today—who are not worrying about the period ahead—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.

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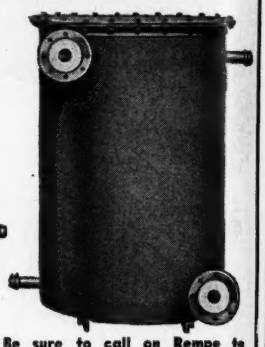

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cannot sag. The "Spread Footing" Foundation (see photo below) holds the original grade PERMANENTLY. Yes, Therm-O-Tile IS Properly Supported.

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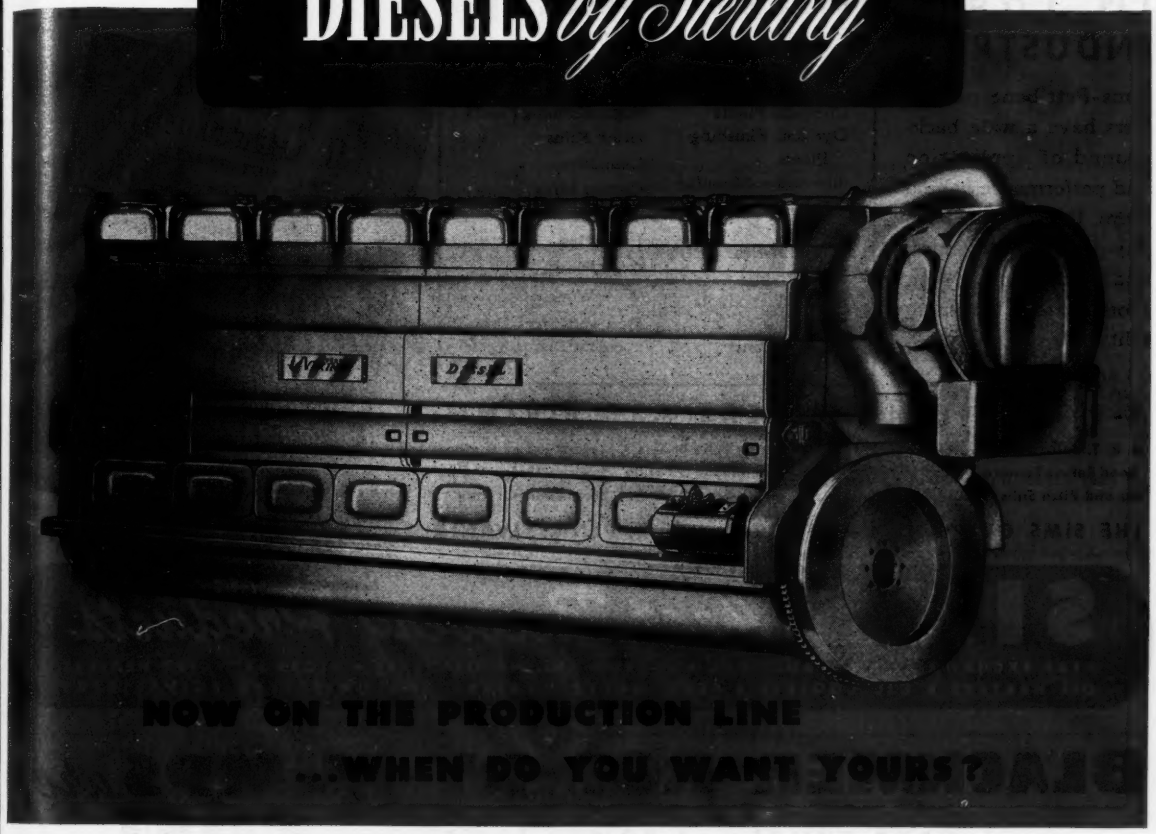

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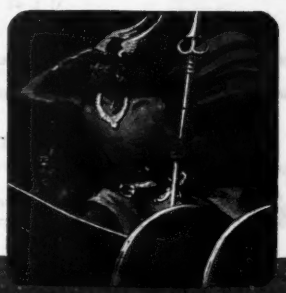

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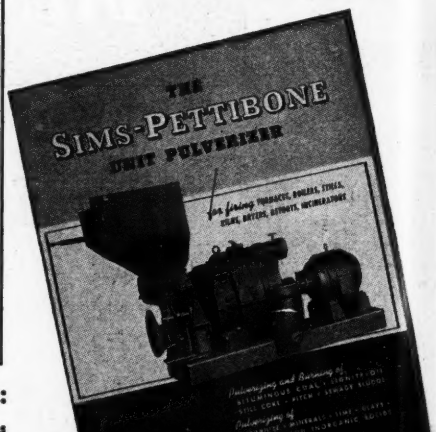

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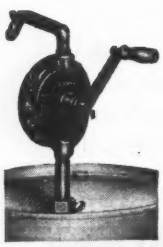
BLACKMER ROTARY PUMPS *are* COST CUTTERS



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The "Bucket Design" swinging vanes automatically compensate for wear. When the "buckets" finally wear out, a simple replacement job restores the pump to normal capacity.

THIS MEANS LOWER PUMPING COSTS

Write for Bulletin No. 306 — Facts About Rotary Pumps

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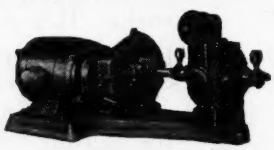

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12,000 *customers — and more — can testify to the indispensability of "American" machines. Here are a few users:* Bureau of Ships, Wash., D. C.; Henry J. Kaiser Co., Calif.; Pacific Bridge Co.; Bethlehem-Hingham Shipyards; Hercules Powder Co.; Stone & Webster; E. I. Du Pont de Nemours & Co.; Crane Co.

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PARACOIL Heat Transfer Equipment is proving its efficiency, rugged construction and economical maintenance on scores of Victory and Liberty Ships.

The U. S. Maritime Commission selected Paracoil Feed Water Heaters as standard equipment on all *Liberty Ships,* and Paracoil Self-Cleaning Fuel Oil Heaters as standard equipment for the pump and heater assemblies illustrated, on more than 500 *Victory Ships.*

Davis Engineering Corporation has built more than 1800 Paracoil Feed Water Heaters for the Liberty Ships and more than 1500 Paracoil Self-Cleaning Fuel Oil Heaters for the Victory Ships.

Paracoil Self-Cleaning Fuel Oil Heaters were preferred by the U. S. Maritime Commission because of the exclusive self-cleaning feature, high heat transfer rates, and small size. The heating surface of these heaters can be regularly cleaned while the heater is *in operation,* an important feature not possessed by any other heat exchanger. Disconnection of piping and disassembly of heater for cleaning is *not* necessary.

Cleaning is accomplished without the mess customarily attendant, at a saving of many man hours and without standby or duplicate equipment.

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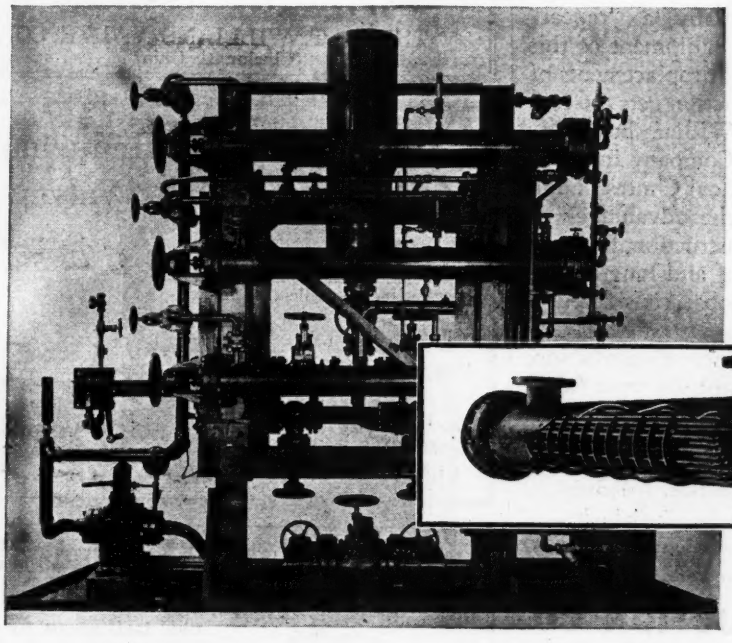
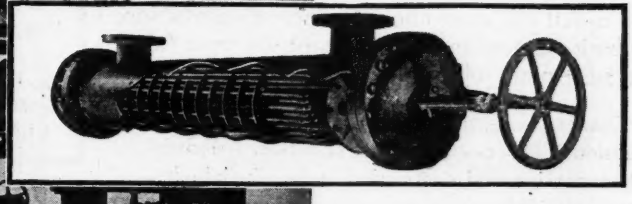
In both Marine and Stationary fields, Paracoil Heat Exchangers have been honored by their selection for jobs requiring the best, because of their reputation for advanced design and high quality of material and workmanship. To all industries using heat exchange equipment, the name "Paracoil" is a symbol of dependable, economical and trouble-free service.

Whatever your particular heat transfer requirement may be, our engineers are at your service to guide you in the selection of proper equipment for your conditions.

Write for Bulletin HE-100 describing the Paracoil Self-Cleaning Tubular Heat Exchanger.





VICTORY SHIP

Oil pumping and heating assembly built by Mid-West Heat Service and Peabody Engineering Corporation. Self-Cleaning Paracoil Fuel Oil Heaters by Davis Engineering Corporation.

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HEAT TRANSFER EQUIPMENT

DAVIS ENGINEERING CORPORATION

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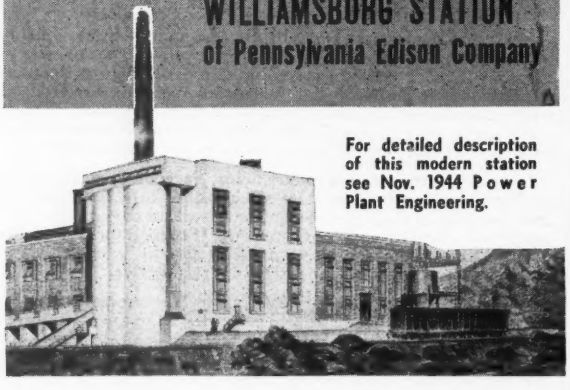
CONNERY
Non-Buckling* Breechings

Installed in New
WILLIAMSBURG STATION
of Pennsylvania Edison Company



For detailed description of this modern station see Nov. 1944 Power Plant Engineering.

ONCE a company puts in Connery Breechings, Ducts, or Uptakes there's usually a "repeat" order in the offing. When more equipment of this type is required—for new plants or replacements of old equipment—Connery Construction gets the call.

This happened recently up at Williamsburg, Pa., where the Pennsylvania Edison Company installed Connery Breechings, Ducts and Coal Chutes. Engineers for the Company knew the advantages of Connery Expansion-Stiffened Construction, had seen it deliver non-buckling, leakproof and long-lasting service on previous Company jobs; considered it still the outstanding buy.

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★Connery Construction—with Accordion-type Expansion Stiffeners—won't warp or buckle. It absorbs all expansion and contraction; stays air-tight because all joints are electrically welded; prevents corrosion and reduces maintenance costs.

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Use **VULCODISC**

for trouble-free valve jobs

In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact, its absorption is less than 1 per cent. . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

THE D. T. WILLIAMS VALVE CO.
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Squires **Reducing Valve**

Will maintain the constant pressure desired regardless of initial pressure. It is a dead end valve.

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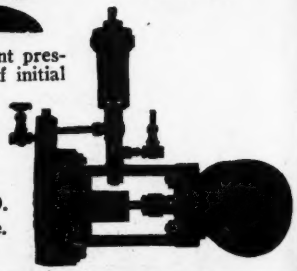

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Lubrication is SAFE and SURE with MANZEL LUBRICATORS

Once feeds are set for the required amount of oil, Manzel Lubricators require no further attention except to replenish oil supply in reservoir. Their positive, clocklike precision insures maximum protection to cylinders and bearings day after day.

Manzel Lubricators eliminate the human element and insure positive lubrication.

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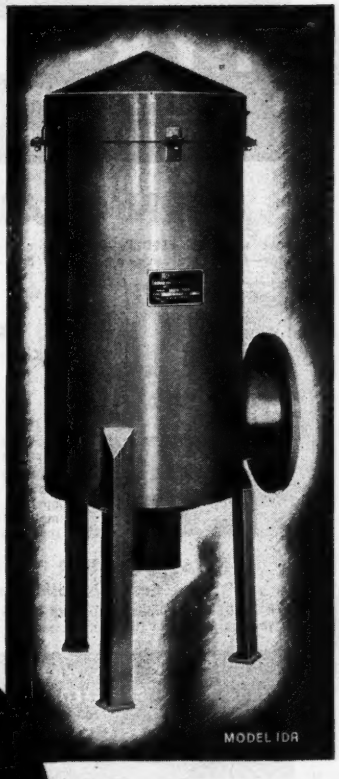
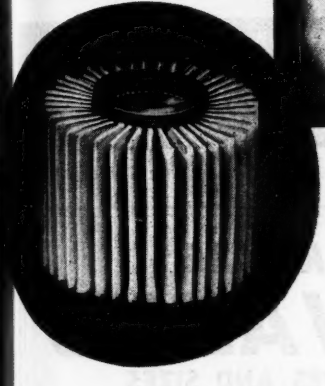
new STAYNEW Intake Air Filter





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- ★ More Filtering Area
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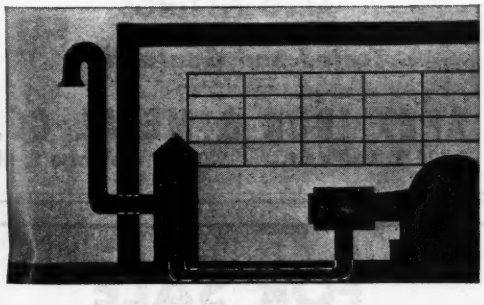
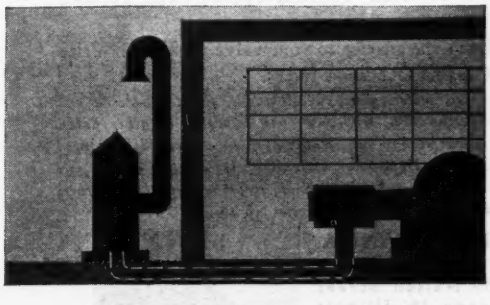
NOW you can equip compressors and internal combustion engines with a Staynew filter providing all the recognized advantages of the famous Protectomotor line . . . *plus* an exclusive combination of two new features.

The new filter, Staynew Model IDR, is so constructed that *installation and servicing can be effected at ground level* (right in the engine room itself if preferred), and the *actual air intake located at the most suitable point.*

Models available with solid base for installation when compressor or engine intake is below floor level.



Model IDR INSIDE Engine Room



Model IDR OUTSIDE Engine Room

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DOLLINGER CORPORATION

(Formerly Staynew Filter Corporation)

31 Centre Pk.

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Can your Valves match this?

The streamlined flow area of a Hills-McCanna valve plus the cushioning effect of its resilient diaphragm does away with the wire drawing nuisance encountered in ordinary valves—whether in wide open or throttling position!

Even when abrasive substances tend to cause wear, the diaphragm seats tightly under compression and the valve cannot leak!

There's no packing—out goes another maintenance problem! The diaphragm isolates working parts from the flow.

Here's the answer to your valve problems! Write for CATALOG V-44 today.

For air, water, gases, acids, alkalis, slurries, volatile and viscous substances, semi-solids and hundreds of other fluids. Pressures to 150 psi. Sizes ½" to 14". Screwed or flanged connections. Handwheel or lever operated types—motor, air or chain operated. Maximum recommended temperatures standard valves 180° F.; special up to 220° F.

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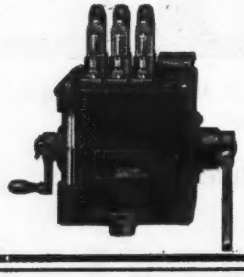
2439 Nelson Street
Chicago 18, Illinois

Hills-McCanna Lubricators (enclosed Type "VSF" illustrated) to serve every need. Available with 1 to 32 pint reservoirs, 1 to 48 feeds.



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Proportioning Pumps — Force Feed Lubricators — Chemical Valves — Air & Water Valves — Marine Valves — Magnesium Alloy Castings

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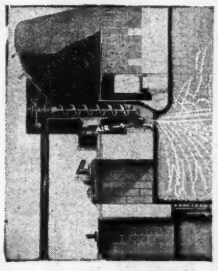
MULTIPLE SPREADER

BURN COAL LIKE OIL!

Save with FYR-FEEDER—Burn less coal—Cheaper coal—Local coals—Screenings—Coal Yard Sweepings, wet or dry—WET coal is no handicap.



FYR-FEEDER exclusively employs air JET coal PROPULSION

Fines burn in suspension, larger pieces are spread evenly over grate.

FYR-FEEDER increases boiler capacity—responds instantly to sudden load variations—requires no special skill or experience to operate—thin fuel bed eliminates clinkers—makes fireman's work much easier—no banking losses.

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Easily installed in minimum time

FYR-FEEDERS are built in sizes to burn from 300 to 12,000 lbs. coal per hour. If you are or expect to be in the market for automatic coal burning equipment

Wire or Write
FYR-FEEDER Stoker Division
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Engineers

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New and Reconditioned Iron and Steel **VALVES**

ALL TYPES AND SIZES
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C E Skelly Industrial Stoker

Moving grate type, 220 HP rating, complete with automatic control. Good condition—in use but one year.

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Every Office Needs a Salvage Chief

"appoint yours today!"

Uselessly stored in many American offices today are tons of *war material!* Vitally needed paper — the raw stuff of blood plasma boxes, shell cases, supply parachutes — *V paper!* It takes many forms . . . dead files, old correspondence, records.

It's easy to put off getting that paper together, bundling it and turning it in. But you should do it for the war effort and for your own sake. Only in this way can we help avoid further civilian paper allotment cuts.

That's why every office should appoint *one person* to act as Salvage Chief. He — or she — can organize the effort, and arrange for regular Paper Salvage days. And the Salvage Chief can remind everyone to adopt conservation measures — to use less paper — as little as possible.

Many organizations which sell their waste paper turn part of the funds over to buy little extras for wounded veterans, or to support some other worthy community project. Thus you have a chance to make your paper serve *twice.*

Get your office paper salvage program rolling *now!*

DOUBLE V PROGRAM

SAVE WASTE PAPER

V TO SPEED VICTORY
V TO AID VETERANS
OR LOCAL PROJECTS

Separate and tie in bundles: 1. Wastebasket scraps. 2. Corrugated boxes, brown paper and bags. 3. Magazines and books. 4. Newspapers.

This advertisement prepared by the War Advertising Council in cooperation with the War Production Board and the Office of War Information. Space contributed to Double V Waste Paper Program by this publication.

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No. 1,866,292

THE Chapman List 960 has quick-acting threads for fast opening and closing—they won't stick or freeze. Full pressure packing prevents transmission of pressure to the stem. Seats and plugs can be superhardened for extra severe services.

Chapman List 960 valves in sizes from ¼" to 2"—carbon steel for pressures to 800 pounds; alloy steel for pressures to 1,000 pounds at 750° F. For higher pressures, specify List 990.

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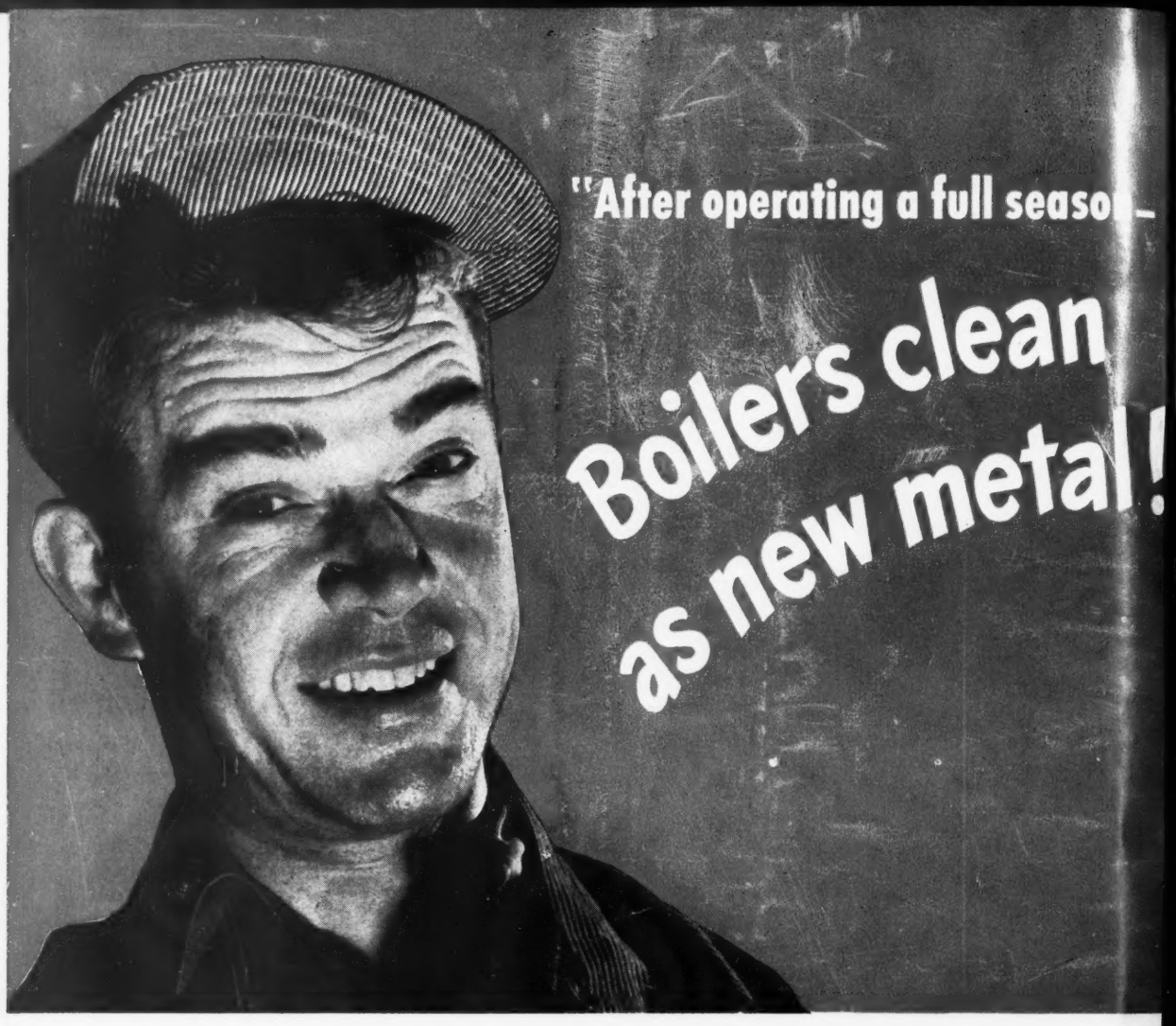

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Permutit* removes these impurities *before the water enters boilers,* preventing shutdowns and destruction of equipment. World's largest manufacturers of water conditioning equipment, Permutit provides *every* process for controlling water quality.

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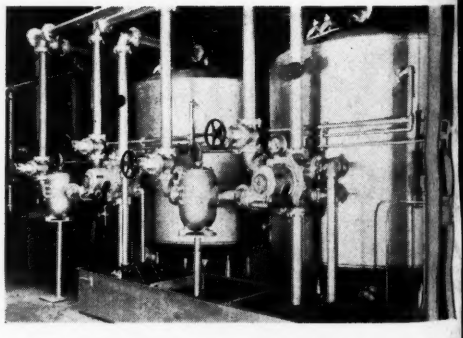

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Serving industry and the armed forces . . . with GOOD WATER!